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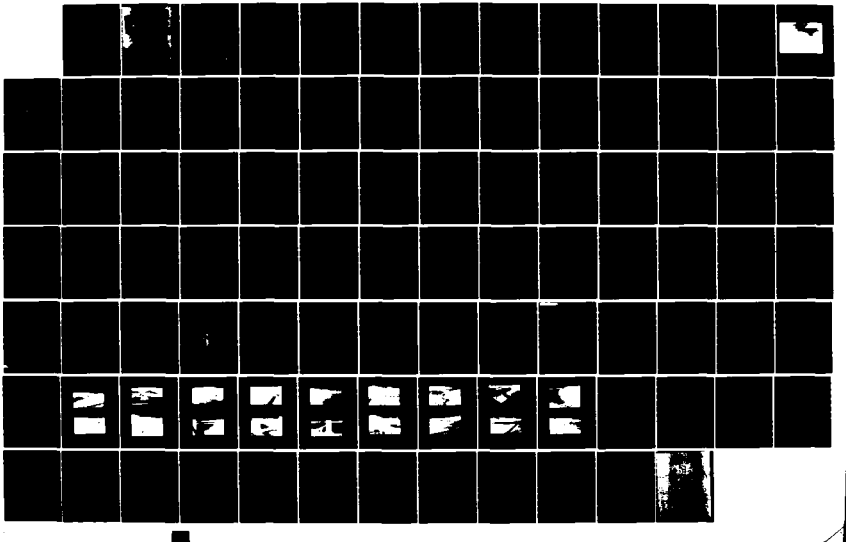

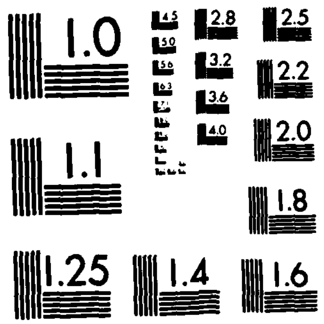

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THAMES RIVER BASIN
COLCHESTER, CONNECTICUT

1

DEEP RIVER RESERVOIR DAM
CT 00346

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

MAY 1979

THAMES RIVER BASIN

COLCHESTER, CONNECTICUT

DEEP RIVER RESERVOIR DAM

CT 00 6

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Deep River Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
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18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Thames River Basin
Colchester, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam at Deep River Reservoir is a zoned earth embankment approximately 900 feet long, 62 feet high with an average crest width of 20 feet. As a result of the visual inspection and the review of available data regarding this facility, the dam is considered to be in GOOD condition. This dam is classified as INTERMEDIATE in size and a HIGH hazard structure. The test flood for this dam is equal to the full PMF.

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NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

Identification No.:	CT 00436
Name of Dam:	Deep River Reservoir Dam
Town:	Colchester
County and State:	New London County, Connecticut
Stream:	Deep River
Date of Inspection:	April 9, 10, 1979

Brief Assessment:

The dam at Deep River Reservoir is a zoned earth embankment approximately 900 feet long, 62 feet high with an average crest width of 20 feet. It was originally constructed in 1926, 7 and raised in 1971, 2 to its present configuration. It is owned by the City of Norwich, Connecticut and operated by the Department of Public Utilities as the main surface water supply of the City. The dam has an ogee overflow spillway at the right abutment. The spillway is a converging chute type with a drop to a stilling basin at the toe of the dam. The outlet works and control tower are centered on the embankment and discharges from the tower's wet well flow through a reinforced 42 inch diameter conduit beneath the dam. An earth embankment dike 240 feet long in an adjacent cove of the reservoir contains an erodable "fuse plug" emergency spillway.

As a result of the visual inspection and the review of available data regarding this facility, the dam is considered to be in GOOD condition. To assure the long-term performance of this structure, several items of concern require attention: modifications need to be made to the existing relief well monitoring system in order to more accurately record the seepage flow, a localized erosion immediately upstream of the left abutment of the dam must be repaired, and vegetal growth in the downstream channel of the emergency spillway should be removed.

This dam is classified as INTERMEDIATE in size and a HIGH hazard structure in accordance with the recommended guidelines established by the Corps of Engineers. The test flood for this dam is equal to the full Probable Maximum Flood (PMF). The

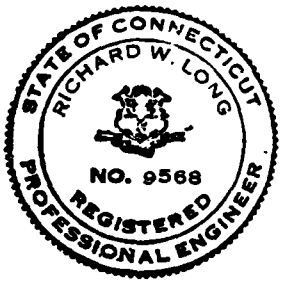
test flood has an outflow discharge equal to 13,000 CFS and has a freeboard allowance of only 2.2 feet below the top of the dam and will not overtop the dam in a stillwater condition. The maximum outflow capacity of the spillway under a stillwater condition is equal to 18,860 CFS which represents more than 100 percent of the test flood.

It is recommended that the Owner engage the services of an engineer experienced in the design of earth dams to accomplish the following: modify the seepage flow weir boxes in order to obtain accurate readings of the flow; restore the localized eroded area of the embankment immediately upstream from the left abutment of the dam; clear the downstream channel of the auxiliary spillway, include in a regular maintenance program exercising of all valves and develop and "post" an emergency action plan.

Recommendations and remedial measures that should be implemented by the Owner within a two year period after receipt of this Phase I Inspection Report are described in more detail in Section 7.

C-E Maguire, Inc.

Richard W. Long, P.E.
Vice President



This Phase I Inspection Report on the Deep River Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

SAUL C. COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR, Chief
Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or to property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any opportunity to detect unsafe conditions.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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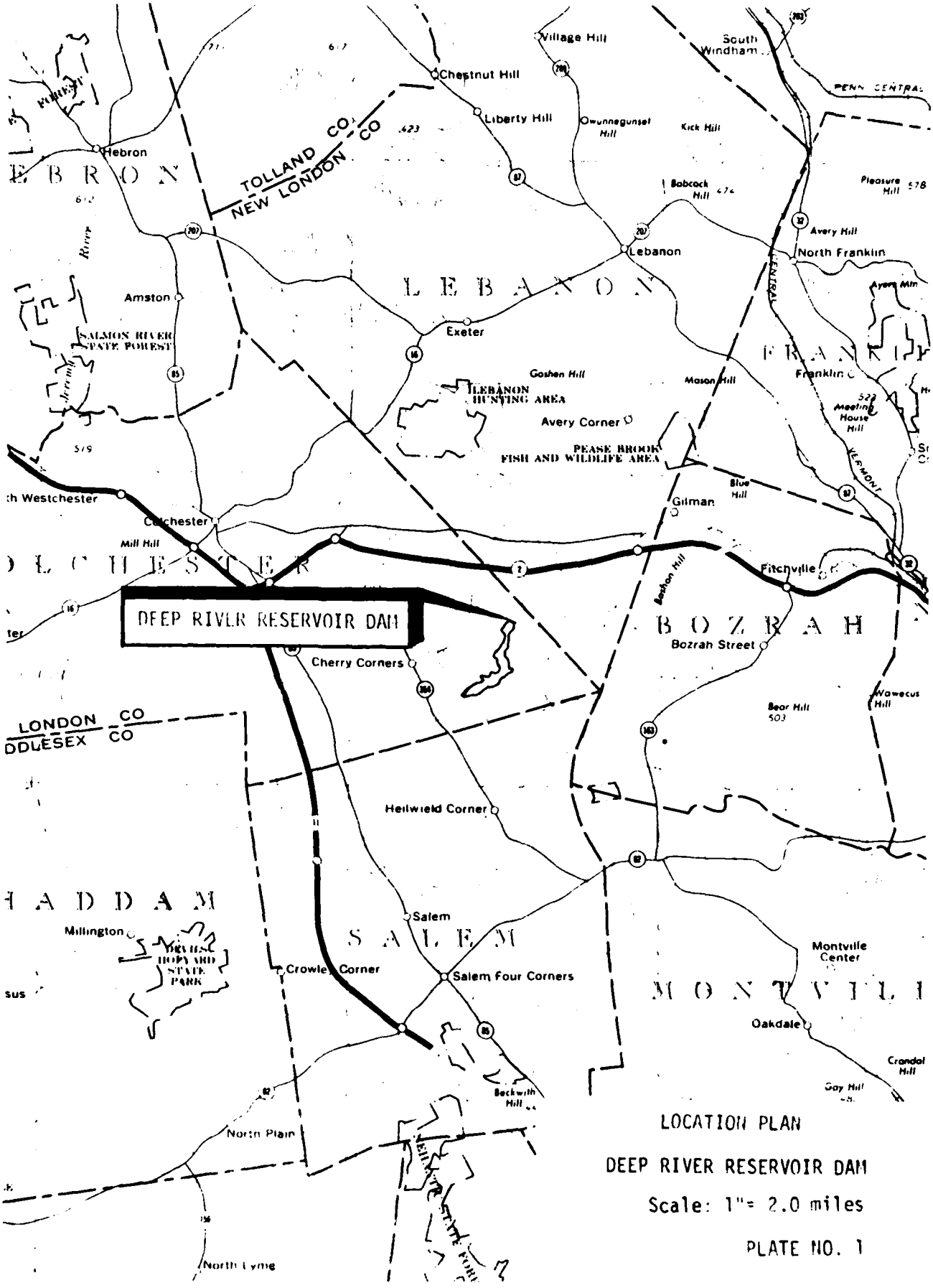
OVERVIEW PHOTO - DEEP RIVER RESERVOIR DAM



LOCATION PLAN

DEEP RIVER RESERVOIR DAM

Scale: 1"= 2.0 miles

PLATE NO. 1

NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

NAME OF DAM: DEEP RIVER RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army through the Corps of Engineers to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. C-E Maguire, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to C-E Maguire, Inc., under a letter from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0015 has been assigned by the Corps of Engineers for this work.

b. Purpose.

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by nonFederal interests.

2. Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

3. To update, verify and complete the National Inventory of dams.

1.2 Description of the Project

a. Location. Deep River Reservoir Dam is located in New London County, Connecticut, approximately 4.5 miles southeast of the village of Colchester, Connecticut. (See Plate No. 1). The dam impounds water from Deep River which drains a 7.40 square mile watershed of moderately steep terrain. The reservoir so formed is a long narrow body of water, approximately 1.5 miles in length with an

average width of 800 feet, generally aligned in a southwest-northeast orientation.

b. Description of Dam and its Appurtenances. The Deep River Reservoir Dam is a zoned earth and concrete core wall dam constructed in 1971 and 1972 at the site of a smaller earth embankment dam originally constructed in 1926 and 1927. The new dam has a maximum height of 62 feet above the bed of the Deep River, a length of about 900 feet (including the spillway) and a maximum width of about 20 feet at the crest; and it incorporates the old dam as part of its upstream face. The upstream and downstream slopes of the dam are approximately 2.25H. to 1.0V., with a 40-feet wide horizontal berm located at mid-height on the downstream slope. The top six feet of the concrete core wall is exposed on the upstream side of the dam. The top 16 feet of the upstream slope of the dam is riprapped, and the entire downstream slope is grassed for erosion protection.

The spillway is located at the right abutment of the main dam. The spillway is a reinforced concrete structure with an uncontrolled ogee-type weir, 90 feet in length.

The intake gates for the outlet works are located in a secured gatehouse structure located on the upstream slope of the dam which is entered by a five-foot wide, 89-foot long service bridge extending from the main dam embankment. The intake gates are manually operated vertical hoist sluice gates. There are three sluice gates for withdrawing water from the reservoir pool each 2 feet wide by 4 feet high with invert elevations at 301.0, 306.0 and 322.0. The outlet conduit leading from the gatehouse is a 42-inch steel lined 48-inch RCP pipe which divides into two branches at the downstream toe of the dam. Flows in both legs of the "Y" are valve controlled with one leg of 42 inch diameter acting as an outlet pipe and the other leg a 30 inch diameter conduit leading to the treatment plant. (See Appendix B-3).

The dike located to the right of the main dam is a 7-foot high, 240-foot long earth embankment structure with a 20.0-foot wide auxiliary spillway included as part of this structure.

A system of relief wells, observation wells and gaging boxes are located on the downstream side of the main dam embankment to allow continual observation of the seepage characteristics of the dam.

c. Size Classification. Deep River Reservoir Dam has an impoundment capacity at the top of dam (Elev. 362.0 National Geodetic Vertical Datum (NGVD) of 8,500 Ac-Ft. and a height of 62.0 feet, which classifies this dam as INTERMEDIATE in size.

d. Hazard Classification. The dam is classified as having a HIGH hazard potential because its failure discharge can cause loss or damage due to high velocity, impact from debris and flooding to five houses, roads (Route 2 and Reservoir Road), public utilities (the water treatment plant for the City of Norwich and power and communication utilities adjacent to the damaged roadways). The estimated water depth due to the possible failure discharge of 124,000 cfs may range in depth from 40 feet at the dam to 8.0 feet at a distance of 8,000 feet downstream.

Loss of this surface water supply will cause a serious health and economic impact on the City of Norwich.

e. Ownership: City of Norwich
Public Utilities Department
Norwich, Connecticut

f. Operator: Public Utilities Department
Water Department
Norwich, Connecticut
Mr. Humphrey Leary
Superintendent of Water
(203)-887-2555

g. Purpose of the Dam. Deep River Reservoir stores water for use in the water supply system for the City of Norwich.

h. Design and Construction History. Deep River Reservoir was formed in 1926 and 1927 when the original dam was constructed across Deep River by the City of Norwich. Plans for the construction of this dam were prepared by Chandler & Palmer, Civil Engineers, Norwich, Connecticut, and included an earth embankment with a concrete core wall, a stepped concrete spillway, and a gatehouse with outlet works.

During 1971 and 1972, the dam was raised 24 feet in height to its present configuration, in accordanced with plans prepared by C-E Maguire, Inc. Providence, Rhode Island. This project included the construction of a new earth embankment, concrete spillway, gatehouse, and auxilliary

earthen dike and spillway. This work was coordinated with the construction of a new water treatment facility downstream from the dam and was completed and in service in early 1973.

i. Normal Operating Procedures. The reservoir water surface level is not generally regulated. Excess water in the reservoir is permitted to flow over the spillway to the stream downstream. Withdrawals for the treatment plant and use in the distribution system of the City of Norwich occur daily and average 5.0 MGD. Minimum releases required during periods of low flow are approximately equal to 1 CFS and are equivalent to the seepage flow quantities through the dam.

1.3 Pertinent Data

a. Drainage Area. The Deep River Reservoir drainage basin, located in New London County, Connecticut, is triangular in shape with a height of 3.25 miles, and a base of 4.54 miles and a total drainage area of 7.40 square miles (See Appendix D for Basin Map.) Five percent of the watershed (0.37 square miles) is swampy or occupied by water storage ponds. The topography is generally rolling terrain with the elevations ranging from a high of 682.0 NGVD to 348.0 at spillway crest. Basin slopes being 0.05 feet to 0.066 feet are generally steep to moderate. The time of concentration for the entire watershed is two to four hours and is relatively small, causing the probability of all surface runoff peaking simultaneously at the reservoir site during a high intensity rainfall event. The small storage area in the watershed tends not to dampen or delay the peak of the surface runoff.

b. Discharge at Dam Site. Discharge records are maintained for flow to the treatment plant only. No record of spillway or outlet work's discharges are available. Listed below are calculated discharge data for spillway and outlet works.

1.	Outlet works; 42" RCP	301.0±
2.	Maximum known flood at dam site (a depth of 3 inches recorded over the spillway) on February, 1979	45 CFS

3.i). Overflow main spillway capacity at maximum pool level(top of dam)	18860 CFS @ elev. 362.0
ii). Overflow main spillway capacity at pool level (Top of Dike)	14960 CFS @ Elev. 360.0
iii). Overflow auxiliary spillway capacity at pool level (top of dike)	2293 CFS @ Elev. 360.0
iv). Total overflow spillway capacity at maximum pool level (top of dam)	22661 CFS @ Elev. 362.0
v). Total overflow spillway capacity at pool level (top of dike)	17250 CFS @ Elev. 360.0
4. Gated outlet capacity at normal pool level (spillway crest)	170 CFS ±. @ elev. 348.0
5. Gated outlet capacity at maximum pool level (top of dam)	195 CFS ±. @ Elev. 362.0
6. Total discharge capacity of main spillway and outlet structure at maximum pool level (top of dam)	19,058 CFS
7. Total discharge capacity of spillways (main and auxiliary) and outlet structure at maximum pool level (top of dam)	27,039 CFS.
8.i). The overflow main spillway capacity at "test flood" level	13,000 CFS. @ elev. 359.8
ii). Gated outlet capacity at "test flood" level	190 CFS.
iii). Overflow auxiliary spillway capacity at "test flood" level	2,200 CFS.

iv). Total outflow discharge at "test flood" level — 15,390 CFS.

c. Elevations (ft. above NGVD)

		DAM	DIKE
1.	Top of dam and dikes	362.0	360.0
2.	Test flood pool elevation	359.80	359.80
3.	Flood control pool	N/A	N/A
4.	Recreation pool	N/A	N/A
5.	Spillway crest	348.0	354.0*
6.	Upstream invert	301.0	350.0
7.	Streambed ds. at center-line of dam and dike	295.0±	350.0
8.	Recorded Maximum Tailwater	Unknown	----

d. Reservoir Lengths (feet scaled)

1.	Length of maximum pool	7500
2.	Length of recreation pool	N/A
3.	Length of flood control pool	N/A

e. Storage (acre-feet)

1.	Water Supply Pool (spillway crest)	4520
2.	Flood control pool	N/A
3.	Test flood elevation	7800
4.	Top of Dam	8500

5. Net storage between top of dam and main spillway crest (Elev. 348.0) is 3980 Ac-Ft. and represents 10.0 inches of runoff from the drainage area of 7.40 square miles.

*Auxiliary Spillway located in dike embankment.

6. One foot of surcharge storage equals 0.72 inches of runoff from the drainage area.

f. Reservoir Surface (acres)

1.	Top dam	325
2.	Maximum pool	320
3.	Flood control pool	N/A
4.	Recreation pool	N/A
5.	Spillway crest (water supply pool)	245

g. Dam

1.	Type (based on visual inspection)	Earth (zoned embankment) with a concrete core wall
2.	Length (including 90 feet of spillway).	900 feet
3.	Height	62 feet
4.	Top width	20 feet
5.	Side slopes	2.25H to 1V
6.	Zoning	Selected Soil Materials
7.	Impervious core	Reinforced concrete core
8.	Cutoff	Sheet Piling
9.	Grout curtain	Partial
10.	Other	----

h. Dike

1.	Type	Earth embankment.

2.	Length	240 Ft.
3.	Height	7 Ft.
4.	Top width	6 Ft.
5.	Side slopes	US 3H to 1V DS 2H to 1V
6.	Zoning	Selected Soil Materials
7.	Impervious core	None
8.	Cutoff	None
9.	Grout curtain	None
10.	Other	The auxiliary spillway is part of the dike embankment and both have a top elevation of 360.0. The auxiliary spillway is 40 feet wide, trapezoidal, with 2:1 side slopes with its channel filled with uncompacted gravel fill meant to "wash out" during high reservoir pool stages. A portion of the downstream channel is riprapped to prevent erosion. See Appendix D.

i. Spillways		MAIN SPILLWAYS	EMERGENCY AUXILIARY SPILLWAYS
1.	Type	Overflow, ogee. Uncontrolled	Overflow broad crest Uncontrolled.
2.	Length of weir	90.0 feet	40.0 feet, trapezoidal with 2:1 side slope
3.	Crest elevation	348.0	354.0
4.	Gates	None	None

5.	U/S Channel	Natural Bed	Same
6.	D/S Channel	Natural Bed	Same
7.	General	----	----
8.	Design Surcharge	9.0 feet	

j. Regulating Outlets

Refer to Paragraph 1.2b, "Description of Dam and Appurtenances", for description of outlet works.

1.	Downstream invert	301.0
2.	Size	48" RCP lined with 42" steel pipe.
3.	Description	RCP
4.	Control Mechanism	Manually operated gear mechanism
5.	Other	---

SECTION 2

ENGINEERING DATA

2.1 Design

The details of the construction of the dam are presented in Section 1.2. The following documents which contain the principal information regarding this design were reviewed.

1. Contract Drawings for Deep River Dam and Water Purification Plant, Charles A. Maguire and Associates, 1970, Drawings D1 - D48.

2. Contract Specifications for Deep River Dam and Water Purification Plant, Charles A. Maguire and Associates, Project 01-1-00329, 1970.

3. Results of Laboratory and Field Investigations, Enlargement of Deep River Reservoir, Goldberg-Zoino & Associates, Inc., June, 1971.

2.2 Construction Data

A complete series of record photographs (8-inch by 10-inch black and white) were taken during the most recent construction activity between April 1971 and November 1972. These photographs were reviewed as part of the Phase I inspection. In addition, information about the construction was provided by members of the C-E Maguire staff who were the designers for the last raising of the crest.

2.3 Operation Data

Daily records are maintained by the Water Department of water surface levels and withdrawals from the reservoir.

2.4 Evaluation

a. Availability. The records for this project are available in the files of C-E Maguire in Providence, Rhode Island and with the Department of Environmental Protection, State of Connecticut, Hartford, Connecticut.

b. Adequacy. Engineering analyses for the hydrologic, hydraulic and geotechnical aspects of the design were available for review. The adequacy of this dam, therefore, was assessed utilizing the design and construction data, the visual inspection and the performance history.

c. Validity. The documents used for this review were the "As-Built" plans and specifications.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. Based on the visual inspection in April, 1979, the dam at Deep River Reservoir and its appurtenances appear to be in GOOD condition. The main embankment was well trimmed and maintained. There was no apparent settlement or misalignment noted. Riprap on the upstream slope was even and distributed with no sloughs or excessive windows observed. An area at the left abutment was eroded but had not been protected by stone armor. The downstream slope was even and well grassed. Relief wells, observation wells and weir boxes at the toe of the dam were all operative and maintained.

The spillway was constructed of reinforced concrete and had an ogee weir section and converging chute to a drop structure and stilling basin at the toe of the dam. At the time of the inspection water was overflowing the weir. No spalling of the concrete or misalignment of concrete monolith joints was observed.

The outlet works for the reservoir consisted of a gate house and wet well intake structure, a 42-inch diameter outlet conduit through the embankment and a valve manhole and headwall outlet at the toe of the embankment. A prestressed concrete service bridge, in good repair, provides access to the gatehouse from the main dam. The gatehouse, bridge and outlet headwall were in good condition and no detrimental deficiencies were noted.

To the west of the main embankment in an adjacent cove of the impoundment an auxiliary emergency spillway is located. This spillway is centered in a dike embankment and designed to "wash out" once an excessive surcharge is imposed on the main spillway. The dike and spillway were well maintained with its approach and discharge channel clear and free of excess vegetation.

Access to the dam was through a roadway adjacent to the water treatment facility for the City of Norwich. This access was gated and locked. It appears that unnecessary trespass and vandalism are well controlled and the general appearance of the entire facility was good.

b. Dam

1. Crest. The crest of the dam is in good condition. The crest is covered with grass which is in good condition and well maintained and supports a service road as shown in Photo C-2, 3. There are no signs of erosion or wear on the crest.

2. Upstream Slope. The upstream slope of the dam is covered with riprap up to 3 ft. in diameter, except where the upper portion of the concrete core wall forms part of the upstream face as shown in Photo C-1. The riprap is in good condition as illustrated in Photo C-1, 2. The upstream slope is clear of vegetation.

3. Downstream Slope. The downstream slope is grass-covered and clear of other vegetation. A midslope berm intercepts surface runoff from the slope and channels it into the toe drain collection system located at the downstream toe as shown in Photos C-3, 4 and 5.

   The downstream slope is in good condition. There are some minor erosion tracks about 2-3 in. wide and 1- to 2-in. deep, and some minor surface sloughing. In general, the erosion is minimal. See Photos C-3, 4, 5, and 13.

   A considerable quantity of water was discharging from the toe drain outlet at the downstream toe into the toe drain collection ditch. The discharge appeared to be free of sediment. The quantity of discharge appeared to be great as shown in Photo C-13. The discharge at this location appears to be a major source of rust-colored staining which was noted in portions of the toe drain collection system. The cause of the staining is not known. The discharge from the drains at the downstream toe is channeled into two box weirs. Discharge from the relief wells is collected in a header pipe and channeled into a third weir box. The weir boxes appear to be too full in both chambers to measure the existing flow since little head difference across the weir opening could be observed. The weir openings were encrusted with a rust-colored floc. (See Photo C-15.)

The ground surface downstream of the downstream toe was wet and spongy in several areas. Photos C-5, 13 and 14 show these wet areas, located approximately 125 feet from the downstream toe. Another wet area located about 100 feet from the downstream toe was located at approximately Sta. 19+00. Piezometer readings taken at the time of the inspection showed the groundwater level to be close to the ground surface. Piezometers and relief wells are located at the downstream toe of the dam. (See Photo C-13.)

c. Appurtenant Structures

1. Spillway. The overflow spillway consists of a chute with concrete floor slab and training walls. The general configuration of the spillway is illustrated in Photos C-6, 7, 8, 16 and the overview photo. Water was overflowing the spillway at the time of inspection. Drain holes are located along the chute near the base of the training walls and in the headwall at the downstream end of the chute. At the time of inspection, one of the drain holes along the chute was discharging as noted in Photo C-7. Both weep holes in the downstream headwall were discharging as indicated in Photo C-8.

2. Emergency Spillway. The emergency spillway consists of an earth dike with an erodable fuse-plug section in the center. The general configuration of the emergency spillway is illustrated in Photo C-11. The dike sections on each side of the erodable section are protected with riprap, as shown in the photo. The downstream channel has been cleared of trees only for a distance of about 300 feet downstream from the dike. See Photo C-12. All discharges from the auxiliary spillway also flow into Deep River downstream from the dam.

3. Outlet Works' Gatehouse. The gatehouse structure is constructed of reinforced concrete in good condition with a service bridge from the main embankment as its sole means of access. No spalling or cracking of concrete surfaces was noted and these structures appeared to be well maintained. See Photos C-2, 3, 10. The wet well of the gatehouse has three manually operated sluice gates (2 ft. wide by 4 ft. high) with invert elevations of 301.0, 306.0, and 322.0. The outlet conduit from the wet well also has a manually

operated gate, and is a 42 inch diameter steel pipe within a 48 inch diameter concrete pipe. This conduit was strengthened in this manner as part of the raising of the dam embankment in 1970-71 by the designers. The outlet conduit divides into two branches at the downstream toe of the dam. A 30 inch diameter branch carries flows to the treatment plant. The 42 inch diameter branch empties into the river below the dam.

4. Pedestrian Access Bridge. Access to the main embankment from the easterly abutment area is by means of a prestressed concrete pedestrian bridge across the overflow spillway chute. This bridge was in good condition. See Photo C-16.

5. Utility Building. A utility building is located on the crest of the main embankment adjacent to the access bridge to the gatehouse. This building houses air compressors which operate aoxygenating bubbler system in the reservoir to improve the quality of the water. This building is shown in Photo C-18.

d. Downstream Channel. The downstream channel is naturally meandering and bordered by a wooded shoreline. No debris was noted, however, periodic inspection should be maintained to assure that it remains unobstructed. See Photo C-9.

At the downstream end of the service spillway chute, the floor of the downstream channel is paved with concrete blocks within approximately 50 feet of the spillway. The channel slopes are covered with riprap for some distance downstream of the spillway.

e. Reservoir Area. The reservoir is formed into a long narrow body of water whose immediate shoreline area has been cleared of vegetation to preclude the occurrence of floating debris. The shoreline appeared to be well covered with grass to prevent sloughing and sedimentation. Immediately adjacent to the left abutment of the main embankment erosion from wave action or ice damage has occurred and consideration should be given to extending the stone protection along this steep slope to minimize additional sloughing. See Photo C-17.

3.2 Evaluation. Based on the visual inspection, the overall dam appearance is good. The inspection disclosed the following items which require attention.

a. It appears that the quantity of discharge from the toe drains and relief wells cannot be monitored with the existing weirs and that they should be modified.

b. The presence of trees in the downstream channel of the emergency spillway could impair the functioning of the spillway in an emergency situation.

c. Erosion of the steep slope upstream from the left abutment of the main embankment should be prevented by extension of the stone armor protection.

d. A continuation of the monitoring of the piezometers and relief well discharges should be continued and plotted by water department personnel in order to detect changes in quantity and sediment transport of the seepage.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures. Deep River Reservoir is the main surface water supply storage facility for the City of Norwich, Connecticut. Water is withdrawn, generally through the upper gate of the control tower at the reservoir and flows through a 30 inch diameter branch of the outlet works conduit to the treatment plant one quarter of a mile downstream from the dam. Approximately 5.0 MGD is withdrawn daily from the reservoir for use in the system. The outlet works conduit is not used to regulate the water surface level in the impoundment and all high reservoir stages are permitted to flow over the uncontrolled spillway.

4.2 Maintenance of the Dam. Operating personnel from the treatment plant inspect the dam daily. Grass is trimmed and brush and tree growth controlled by water department personnel during the warmer months. Observation wells (peizometers) are read twoce each month and flows through the seepage weir boxes are measured as well. The dam and its appurtenances appears to be well maintained.

4.3 Maintenance of the Operating Facilities. It was reported that only two of the gates that are used are exercised periodically to assure their continued service. The control valve, which permits reservoir water to enter the river below the dam at the downstream end of the outlet conduit has not been used in several years. Reservoir levels and inflow from the impoundment are recorded automatically at the treatment plant. Aoxygenating system to improve the water quality was in operation at the time of the inspection.

4.4 Description of Any Warning System in Effect. Emergency action and/or warning would be coordinated through the Water Department main office in Norwich and the field personnel at the treatment plant. No formal emergency or contingency plan is in effect to reduce or minimize downstream damage in emergency situations.

Monitoring of the approach of intense storm activity is normally through the U.S. Weather Service or local weather forecasts.

4.5 Evaluation. A program of regular operational checks of the control valves of the outlet conduit and the intake gates to the wet well chamber of the gatehouse should be implemented to assure that they are operational.

Readings of the observation wells and relief well weir boxes should be plotted on a regular basis coincident with the reservoir pool level and a history developed in order to detect changes if they should occur.

Minor erosion on the main embankment should be repaired during maintenance landscaping activities.

An "Emergency Action Plan" should be prepared to prevent or minimize the impact of failure. This plan should list the expedient action to be taken and authorities to be contacted.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. Deep River Reservoir Dam, originally constructed by the City of Norwich in 1926, 7 was raised to its present height and dimensions in 1971, 2. The dam is located on Deep River approximately 9 miles west of the City of Norwich in New London County, Connecticut and serves as the water supply source for the City of Norwich, Connecticut.

This dam has a main overflow spillway length of 90.0 feet and a total surcharge height of 14.0 feet between the top of the dam and the spillway crest. The total length of the dam is 900 feet. The reservoir has a storage capacity of 4520 Ac-Ft. at spillway crest (elevation 348.0) and can accommodate 11.45 inches of runoff from a drainage area of 7.4 square miles. Fourteen feet of depth in the reservoir above the spillway crest can accommodate 3980 Ac-Ft. of volume equivalent to 10.0 inches of runoff as a surcharge storage.

Because 3980 Ac-Ft., equivalent to 10.0 inches of runoff from the watershed, is available as surcharge storage, this dam is considered basically a large storage facility. The maximum spillway capacity of 17,250 CFS at top of dike (Elev. 360.0) is more than 100 percent of the test flood outflow making the reservoir a high spillage facility. Because the dam is an earth embankment, it is considered to be less stable against overtopping due to erosion.

b. Design Data.

Specific design data was available for computing inflow/outflow values of discharge for the test flood (PMF) and other less frequent events. Where specific design data was lacking, U.S.G.S. Topographic Maps (Scale 1" = 2000') were utilized to develop hydrologic parameters such as reservoir surface areas, basin slopes, time of concentration and other runoff characteristics. Elevation - storage relationships for the reservoir were known. Surcharge storage was computed assuming that the actual surface area remained constant above the spillway crest. Some of the pertinent hydraulic design data was obtained and/or confirmed by actual field measurements at the time of the visual field inspection.

For outflow values (routing procedures) and dam failure profiles were computed in accordance with the guidelines developed by the Corps of Engineers. Final values outlined in this report, which are quite approximate and should not be considered a substitute for actual detail analysis.

c. Experience Data. Historical data for recorded daily discharges and water surface elevations are available for this dam or the watershed. Seepage quantities and observation well readings as observed by the owner are also available.

d. Visual Observations. No evidence of detrimental damage to any portion of the facility was visible at the time of the inspection. Seepage quantities seemed to be somewhat excessive, but water was clear and exiting at proper locations (toe drain). Surface erosion was noted at the left abutment of the dam on a steep unprotected slope.

e. Test Flood Analysis. Recommended guidelines for Safety Inspection of Dams by COE were used for selection of the "Test Flood." This Dam is classified as a HIGH hazard and INTERMEDIATE size structure. Guidelines indicate that a full PMF should be used as a test flood for such classifications. The watershed has a total drainage area of 7.4 square miles, of which 0.37 square miles (5 percent) is swampy or covered by storage ponds. The basin slope averages 0.05 ft/ft which is judged as steep to moderate and rolling terrain. A "test flood" equal to the full PMF was calculated to be 2700 CSM, equal to 20,000 CFS for this drainage area of 7.4 square miles and was adopted as the "test flood." Outflow discharges were also developed using Corps of Engineers' criteria for approximate routing methods. Outflow discharge for the test flood inflow was 13,000 CFS. Additional design data developed for this investigation has been tabulated at the end of this section.

The spillway capacity is hydraulically adequate to pass the "test flood" (FULL PMF) and overtopping would not occur. However, the test flood in a still reservoir has a freeboard allowance of 0.20 ft. and 2.20 ft. from the top of the dike and dam, respectively. The inflow and outflow discharge values for this test flood are 20,000 CFS and 13,000 CFS, respectively. The maximum outflow capacity of the spillway, in a still reservoir condition, without overtopping of the dam is 18,860 CFS, or the dike is

17,250 CFS both of which are more than 100 percent of the test flood overflow discharge. Overtopping potential for discharges of lesser magnitudes and frequencies computed approximately, are tabulated at the end of this section. A spillway and outlet rating curve are included in Appendix D of this report.

At the spillway crest elevation of 348.0, the capacity of the outlet structure is 170 CFS. Considering the use of the outlet works to regulate the pool level for expected inflows, it will require 17 hours to lower the reservoir level the first foot assuming a surface area of 245 acres.

One foot of depth in the reservoir below the spillway crest is equivalent to 0.62 inches of effective rainfall from the watershed.

f. Dam Failure Analysis. This dam is classified as a high hazard structure because its failure discharge can cause damage due to high velocity, impact from debris and flooding to five dwellings, Route 2 and Reservoir Road, the Water Treatment Plant for the City of Norwich and public utilities adjacent to the damaged roadways. The calculated dam failure discharge of 124,000 CFS assuming impounded water level is at the top of the dam, will produce an approximate water surface elevation of 341.0 immediately downstream from the dam. This will raise the water surface approximately 35.0 feet above the depth just prior to failure when the discharge is 18,860 CFS. Normal uniform flow, based on Manning's Formula, will occur approximately 8,000 feet downstream from the dam with a depth of flow equal to 8.0 feet. For a distance of 8,000 feet from the dam, the depth of flow will decrease from 35.0 feet to 8.0 feet. Water surface elevations due to failure of the dam are computed and are listed in Appendix D. Probable consequences including the prime impact areas, if the dam were to fail, are also listed in Appendix D.

DEEP RIVER RESERVOIR DAM

Inflow, Outflow and Surcharge Data

FREQUENCY IN YEARS	24-HOUR TOTAL RAINFALL IN INCHES	24-HOUR* EFFECTIVE RAINFALL IN INCHES	MAXIMUM INFLOW IN CFS	MAXIMUM** OUTFLOW IN CFS	SURCHARGE HEIGHT IN FEET	SURCHARGE STORAGE ELEVATION
10	5.0	2.6	2740	1100	2.1	350.1
50	6.5	4.1	4300	2150	3.3	351.3
100	7.0	4.5	4800	2900	4.0	352.0
1/2 PMF	11.9	9.5	10000	7000	7.2	355.2
TEST FLOOD = PMF	21.4	19.0	20000	13000	11.8	359.8

*Infiltration assumed as 0.1"/hour.
**Lake assumed initially full at spillway crest elevation 348.0
(top of dam = 362.0)

NOTES:

1. Q_{10}; Q_{50}; Q_{100}; inflow discharges were computed by the approximate methodology of the Soil Conservation Service.

2. 1/2 PMF and the "test flood" computation is based on COE guidelines.

3. The maximum capacity of the spillway without overtopping the dam is equal to 18,860 CFS and 17,250 CFS at Top of Dike, Elev. 360.0.

4. All discharges indicated are dependent upon the continued integrity of upstream storage facilities if applicable.

5. Surcharge storage is allowed to overtop the dam when exceeding the spillway capacity.

6. Test flood = Full PMF = 2700 CSM = 20,000 CFS
(D.A. = 7.4 square miles.)

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation. There are no signs of structural instability evident.

b. Design and Construction Data. The design data presented in Section 2 of this report do not point to any sources or areas of structural instability.

c. Operating Records. Readings of observation wells and relief well orifice measuring boxes have been taken twice monthly, however, these readings have not been compared with the historical record established. It is important that a record be established which will clearly define the reaction of the wells and orifice box readings to the reservoir level in order to properly monitor the seepage and phreatic level through the impact.

d. Post-Construction Changes. No post construction changes have occurred pertinent to the embankment or foundation stability. A check of the survey reference marks implanted along the core wall top at each joint need to be included in the periodic inspection conducted by Water Department personnel to record changes in the vertical and horizontal alignment.

e. Seismic Stability. This dam is in Seismic Zone 1 and in accordance with the recommended guidelines does not warrant seismic analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based on the visual inspection, available records of the site and the past operational performance, the dam and its appurtenances at Deep River Reservoir is judged to be in GOOD condition. Items of concern which must be corrected in order to assure the long-term performance of this structure are listed in Sections 7.2 and 7.3.

b. Adequacy of Information. The information available and a visual inspection are not sufficient to fully analyze the long-term performance of the dam. At this time, an assessment of performance is based solely on available design drawings and on a visual inspection.

c. Urgency. The recommendations described below should be implemented by the Owner within two years after receipt of this Phase I Inspection Report. Modifications to the weir box orifices should be completed immediately in order to begin an accurate record of seepage flows through the embankment.

d. Need for Additional Information. A comprehensive investigation is not required for this facility at this time. However, additional engineering input is required to conduct the recommendations and remedial measures outlined in Sections 7.2 and 7.3.

7.2 Recommendations. The Owner should engage the services of an engineer experienced in the design of earth dams to accomplish the following:

a. The existing seepage flow weir boxes should be modified in order to better record the quantity of flows. It is suggested that V-notched weir plates be used as a replacement for the orifice plates in use at present. These readings should be obtained regularly and plotted so that a comparison can be made to denote any changed condition. Levels of the reservoir pool must also be recorded at the time of the seepage readings.

b. The erosion of the embankment immediately upstream from the left abutment of the main dam must be repaired. Consideration should be given to extending stone armor

protection along this slope due to its steepness and exposure.

c. The presence of trees in the downstream channel of the emergency spillway could create a backwater condition which might impair the functioning of the spillway in an emergency situation. This possibility should be investigated and the trees removed if necessary.

7.3 Remedial Measures

a. Operation and Maintenance Procedures

1. A program of regular operational checks of all the control valves of the gatehouse and outlet works should be implemented and incorporated into a regular maintenance schedule.

2. Develop and "post" an emergency action plan including a warning system in order to prevent or minimize the impact of dam failure. It should include the expedient action to be taken, authorities to be contacted and locations of emergency equipment and materials.

3. Continue the technical inspection of this facility on a biennial frequency.

4. Include in the monitoring program a check of the survey reference marks implanted in the core wall for alignment changes in the embankment.

7.4 Alternatives

None

APPENDIX A

INSPECTION CHECK LIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Deep River Reservoir DATE April 9, 10, 1979

TIME --

WEATHER P.C. Cool

W.S.ELEV. _____ U.S. _____ D.S.

PARTY:

1. S. Khanna - CEM
2. D. Sluter - CEM
3. R. Brown - CEM
4. R. Michniewicz - CEM
5. R. Murdock - GEI
6. D. Shields - GEI
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Deep River Reservoir Dam DATE April 10, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	El. 362
Current Pool Elevation	El. 348.10
Maximum Impoundment to Date	
Surface Cracks	None observed
Pavement Condition	Dirt roadway along crest - good cond.
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	No evidence
Sloughing or Erosion of Slopes or Abutments	Minimal
Rock Slope Protection - Riprap Failures	Riprap in good condition
Unusual Movement or Cracking at or Near Toe	None observed.
Unusual Embankment or Downstream Seepage	Ground surface d.s. of d.s. toe was wet and spongy in several areas.
Piping or Boils	None observed.
Foundation Drainage Features	Plans show vertical chimney drain connected with a toe drain collection system.
Toe Drains	Riprap covered--good condition. Discharging at time of inspection.
Instrumentation Systems	Survey pins on core wall, piezometers d.s. from toe, seepage collection system with weirs.
Vegetation	Grass cover on d.s. slope

PERIODIC INSPECTION CHECK LIST

PROJECT Deep River Reservoir Dam DATE April 9, 10, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Not observable, underwater
Bottom Conditions	Not observable, underwater
Rock Slides or Falls	Not observable, underwater
Log Boom	None
Debris	Not observable
Condition of Concrete Lining	Not observable
Drains or Week Holes	Not observable
b. Intake Structure	Wet well chamber of gatehouse control structure in operation; interior of chamber not observable.
Condition of Concrete	
Stop Logs and Slots	

PERIODIC INSPECTION CHECK LIST

PROJECT Deep River Reservoir Dam DATE April 9, 10, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	Good
General Condition	Good
Condition of Joints	Good
Spalling	None observed
Visible Reinforcing	None observed
Rusting or Staining of Concrete	None observed
Any Seepage or Efflorescent	None observed
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	None observed
Cracks	None observed
Rusting or Corrosion of Steel	None observed
b. Mechanical and Electrical	
Air Vents	Open louvers
Float Wells	Float Well Indicator in operation and recorded at treatment plant.
Crane Hoist	Operable.
Elevator	None
Hydraulic System	None
Service Gates	One intake gate (upper) remains permanently open. Others have not been exercised recently.
Emergency Gates	
Lightning Protection System	None
Emergency Power System	Manual gates
Wiring and Lighting System	Operable

PERIODIC INSPECTION CHECK LIST

PROJECT Deep River Reservoir Dam DATE April 9, 10, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Not Observable Plans indicate existed 48 inch diameter RCP was strengthened by use of a 42-inch diameter steel liner. Existing 48" pipe was also extended to accommodate the larger embankment configuration.

PERIODIC INSPECTION CHECK LIST

PROJECT Deep River Reservoir Dam DATE April 9, 10, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	Not observable. Outlet conduit discharges at water treatment plant several thousand feet downstream from dam. Headwall below the dam did not indicate any apparent leakage along the conduit. Valve chamber was full of groundwater, but no noticeable flow was noted.

PERIODIC INSPECTION CHECK LIST

PROJECT Deep River Reservoir Dam DATE April 9, 10, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Unobstructed approach, directly from reservoir pond.
General Conduit	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Not observable
b. Weir and Training Walls	Converging rectangular concrete chute.
General Conduit of Concrete	Good
Rusting or Staining	None observed.
Spalling	None observed
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	Seepage observed through drain holes.
Drain Holes	Yes
c. Discharge Channel	Riprapped near tail of chute, natural channel downstream from riprap.
General Condition	Good
Loose Rock Overhanging Channel	None observed.
Trees Overhanging Channel	Trees overhang channel several hundred ft. downstream from tail of chute.
Floor of Channel	Not observable
Other Obstructions	None observed.

PERIODIC INSPECTION CHECK LIST

PROJECT Deep River Reservoir Dam DATE April 9, 10, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	Concrete two-span
Bearings	Elastomeric
Anchor Bolts	Not observable
Bridge Seat	Concrete
Longitudinal Members	Concrete
Under Side of Deck	Concrete
Secondary Bracing	None
Deck	Concrete
Drainage System	None (Pitches off walkway).
Railings	Yes
Expansion Joints	Yes (Between spans)
Paint	None
b. Abutment & Piers	Concrete abutment at dam, bears on control tower at upstream end.
General Condition of Concrete	Good
Alignment of Abutment	Good
Approach to Bridge	Perpendicular to dam axis.
Condition of Seat & Backwall	Good

PERIODIC INSPECTION CHECK LIST

PROJECT Deep River Reservoir Dam DATE April 9, 10, 1979

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	El. 360.0
Current Pool Elevation	El. 348.1
Maximum Impoundment to Date	
Surface Cracks	None observed
Pavement Condition	No pavement
Movement or Settlement of Crest	None observed.
Lateral Movement Vertical Alignment	Alignment good, no settlement
Horizontal Alignment	Good
Condition at Abutmentand at Concrete Structures	No sloughing, cracking, or settlement observed.
Indications of Movement of Structural Items on Slopes	No structural items on slopes.
Trespassing on Slopes	None observed.
Sloughing or Erosion of Slopes or Abutments	None observed.
Rock Slope Protection - Riprap Failures.	Good Condition
Unusual Movement or Cracking at or near Toes	None observed.
Unusual Embankment or Downstream Seepage	None observed.
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None (Auxiliary dike contains erodable fuse plug spillway for emergency high reservoir stages.)

APPENDIX B

ENGINEERING DATA

APPENDIX B-1

DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS AND LOCATION

Victor J. Galgowski, Dam Safety Engineer
Department of Environmental Protection
State Office Building
165 Capital Avenue
Hartford, Connecticut 06115

Humphrey Leary, Superintendent Water Division
Department of Public Utilities
P. O. Box 1008
34 Shetucket Street
Norwich, Connecticut 06360

APPENDIX B-2

COPIES OF PAST INSPECTION REPORTS

STATE OF CONNECTICUT

STATE BOARD FOR THE SUPERVISION OF DAMS

STATE OFFICE BUILDING · HARTFORD 15, CONNECTICUT

November 19, 1956

Re: Deep River Reservoir
Colchester, Connecticut

Mr. William S. Wise
Chairman
State Board for Supervision of Dams
Hartford, Connecticut

Dear Sir:-

Last Saturday I visited the Deep River Reservoir owned by the City of Norwich in the Town of Colchester. As you perhaps know, this dam was built quite a few years ago from plans prepared by this office. The dam and spillway went successfully through the 1938 flood and all subsequent floods without damage. There is a little repair work on the lower end of the spillway that needs to be taken care of and I am calling this to the attention of the Local Department. This does not effect the stability of the dam in any way and I consider that the dam is in good shape and meets all of the requirements of the State.

Very truly yours,

B H Palmer

Member, State Board for Supervision of Dams

BHP/ew

April 13, 1963

Mr. Philip L. White
General Manager
Public Utilities
Norwich, Connecticut

Dear Sir:-

I have today inspected the Deep River Dam at Colchester. This is part of the City of Norwich water supply and the dam is located about two miles South of the Norwich-Colchester Road near the Lebanon-Colchester Town line.

The dam was built in 1926-27 by the City of Norwich and consists of an earth dam with a concrete core wall in center. Some steel sheeting was also driven at the bottom of the core wall. The spillway is 60 feet wide and abutment walls at spillway are 5 feet high. The dam took the flood of 1938 without damage. Drainage area is 8½ square miles.

The dam and embankment look good. There is some damp ground downstream from the dam but this is from springs in the ground and no leaks are visible.

The concrete on some of the concrete slabs of the spillway near the top are showing some erosion due to frost and ice. These should be repaired this Summer under the head of maintenance. It is nothing serious but should be attended to when weather permits. About 1" of water was coming over the spillway at time of inspection.

Other than the items mentioned above I consider the dam to be in good condition.

Very truly yours,

CHANDLER & PALMER

B H Palmer

BHP/ew
c.c.: Mr. Emitt A. Dell

STATE OF CONNECTICUT

WATER RESOURCES COMMISSION

STATE OFFICE BUILDING • HARTFORD, CONNECTICUT 06115

February 5, 1969

Memo to: File

From: William H. O'Brien III

Subject: Deep River Dam - Colchester

On January 23, 1969, the undersigned inspected the subject dam in the company of Mr. Humphrey Leary, Superintendent, Town of Norwich Public Utilities Department. There was one inch of water flowing over the spillway.

The waste channel is of stepped construction and was Gunnited in 1963 and appears in excellent condition. Permission had been given for the installation of flashboards in letter dated February 14, 1945 from Richard Martin. Flashboards were not in place on the date of inspection although iron pins at 5½ foot ± spacing were in place. Two pins were missing and the remainder were bent over indicating that flashboards are not currently in use. Brush and trees on this dam referred to in September 28, 1967 letter from John Mozzochi have been removed. Some brush was left at the toe of the downstream embankment and should be removed.

There were two woodchuck holes observed in the downstream slope. One was one hundred to 150 feet east of the west end and 8 feet up the embankment. The other was 100 to 150 feet west of the east end of the dam and 4 feet up from the toe.

about 1 foot

There was quite a bit of seepage or leakage coming from the toe of this dam, on the order of magnitude of 5 gallons per minute. Along the toe at the western side of the dam, the seepage appeared to be general in nature and not emanating from any one point, and amounted to approximately 2 gallons per minute. Near the middle of the downstream toe, this seepage joined with seepage emanating from the toe of the embankment at the easterly toe amounting to approximately 3 gallons per minute. A small flow was observed downstream from the spillway channel approximately 20 feet downstream from the toe of the embankment. The downstream embankment was quite mushy for three feet up from the toe of the slope, indicating that this area may be saturated. Mr. Leary said that there was a spring approximately 6 inches underneath the dam on the downstream side of the core wall.

Plans in this office indicate that the dam was designed to be raised at a future date. A letter in our files dated Apirl 7, 1947 to Benjamin Palmer from Linwood Mort states that he had received plans for the raising of this dam and had approved them, but we have no such record of these plans, or knowledge that the dam was raised. A letter has been written to Mr. Grimshaw of the Public Utilities Department requesting plans and specifications if this dam was raised.

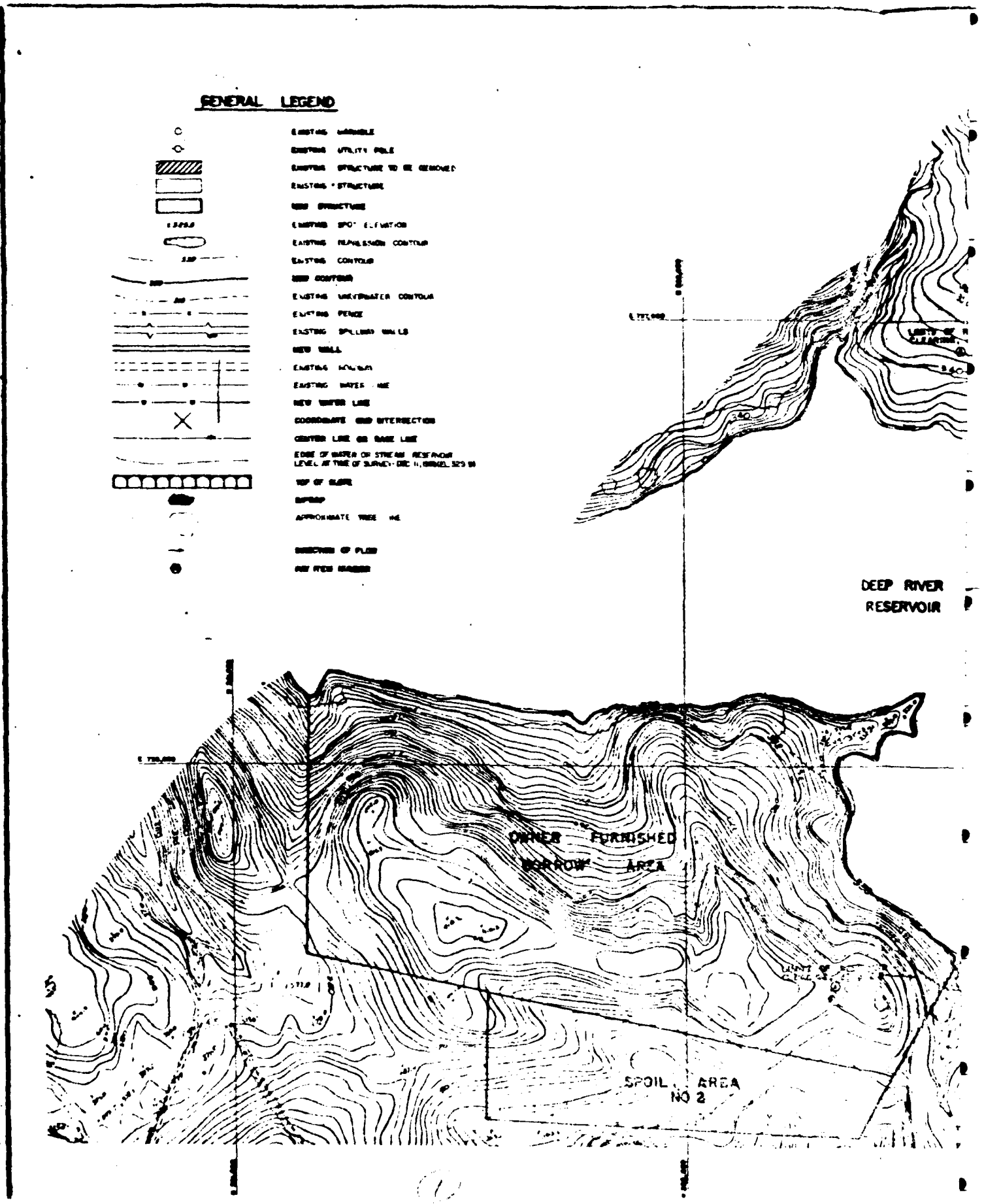
When additional information has been received, the matter of this leakage should again be investigated and corrective action taken if necessary.

William H. O'Brien
Civil Engineer

WHOIII:vhb

APPENDIX B-3

RECORD DRAWINGS AND SKETCHES


GENERAL LEGEND
DEEP RIVER
RESERVOIR
OWNER FURNISHED
BORROW AREA
SPOIL AREA
NO 2

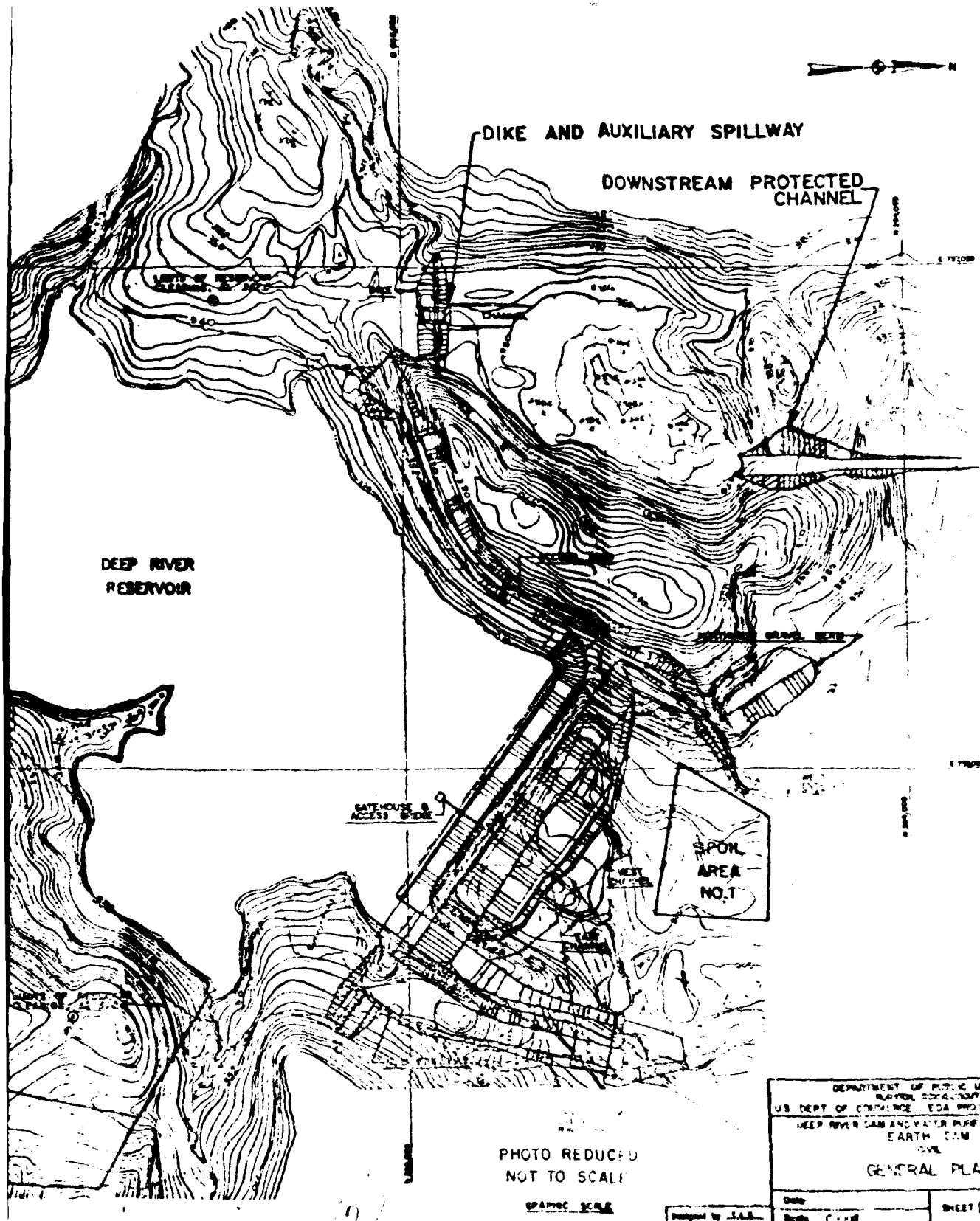


PHOTO REDUCED
NOT TO SCALE

GRAPHIC SCALE

DEPARTMENT OF PUBLIC UTILITIES
RIVERTON, CONNECTICUT
U.S. DEPT OF COMMERCE - EDA PROJECT NO 01-11-0038

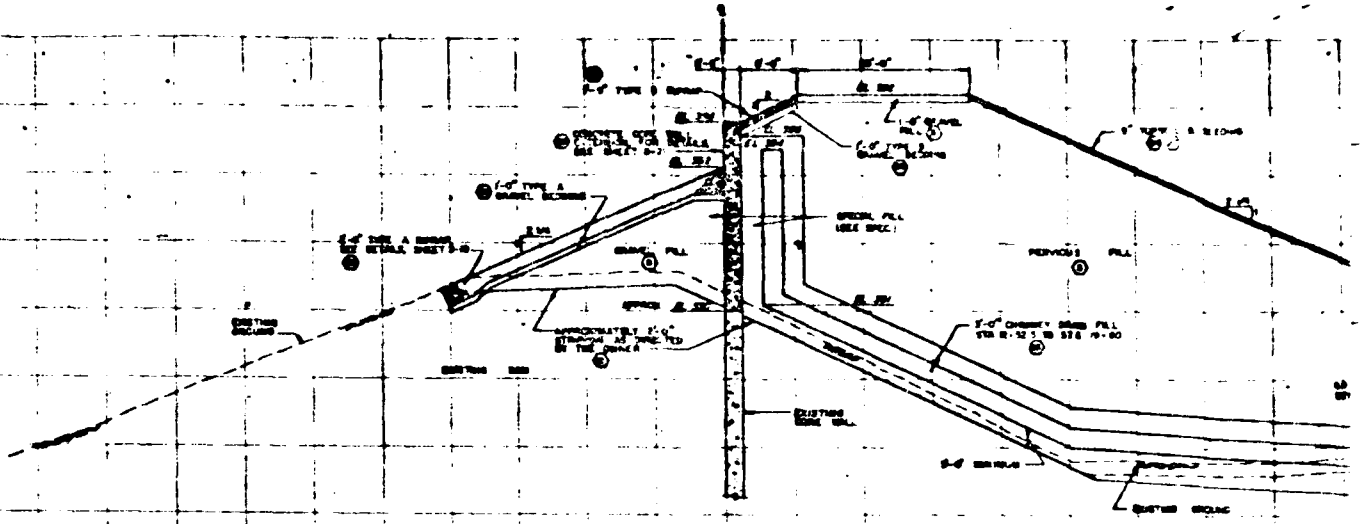
DEEP RIVER DAM AND WATER PURIFICATION PLANT
EARTH DAM
CIVIL

GENERAL PLAN

Date
Scale 1" = 40'

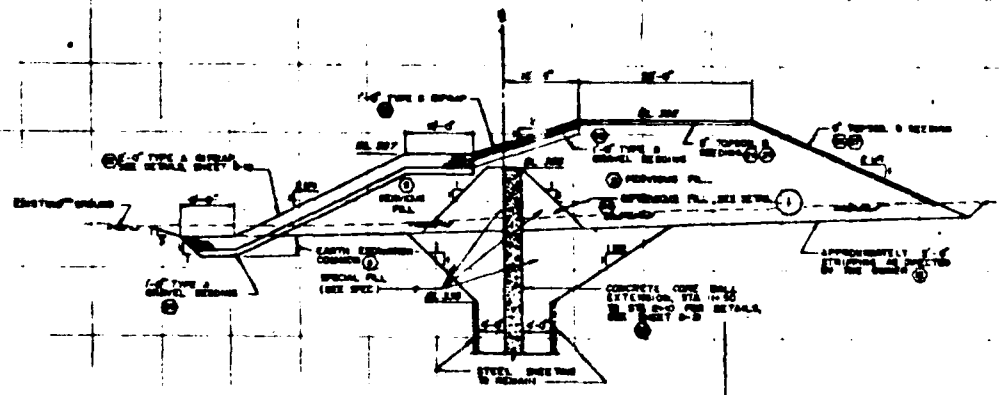
SHEET D- 2 OF D-48

CHARLES A. MAGUIRE & ASSOCIATES INC.



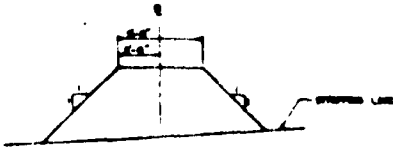
TYPICAL SECTION

(STA. 12+52.5 TO STA. 9+60)

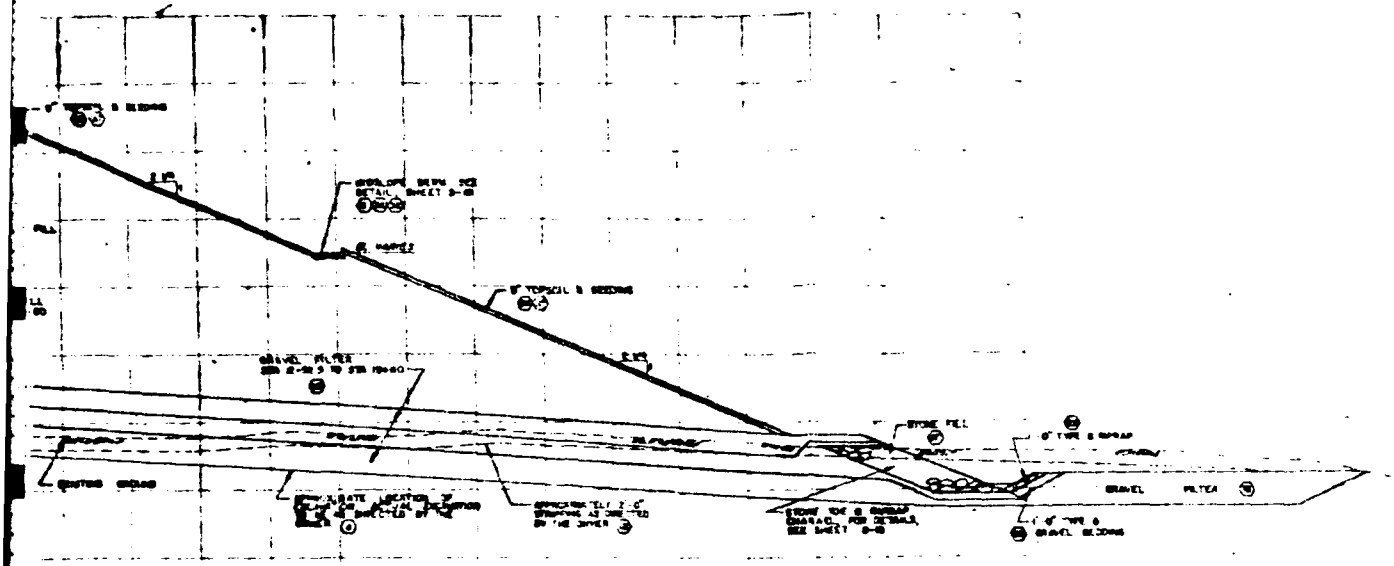


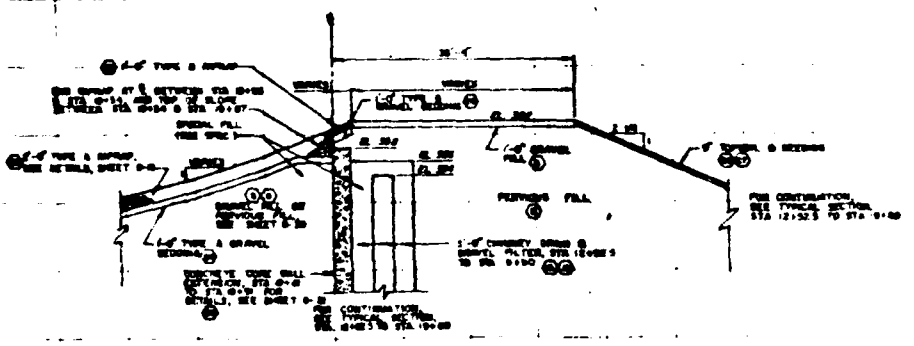
TYPICAL SECTION

(STA. 10+65 TO STA. 11+62.5)



DETAIL ①





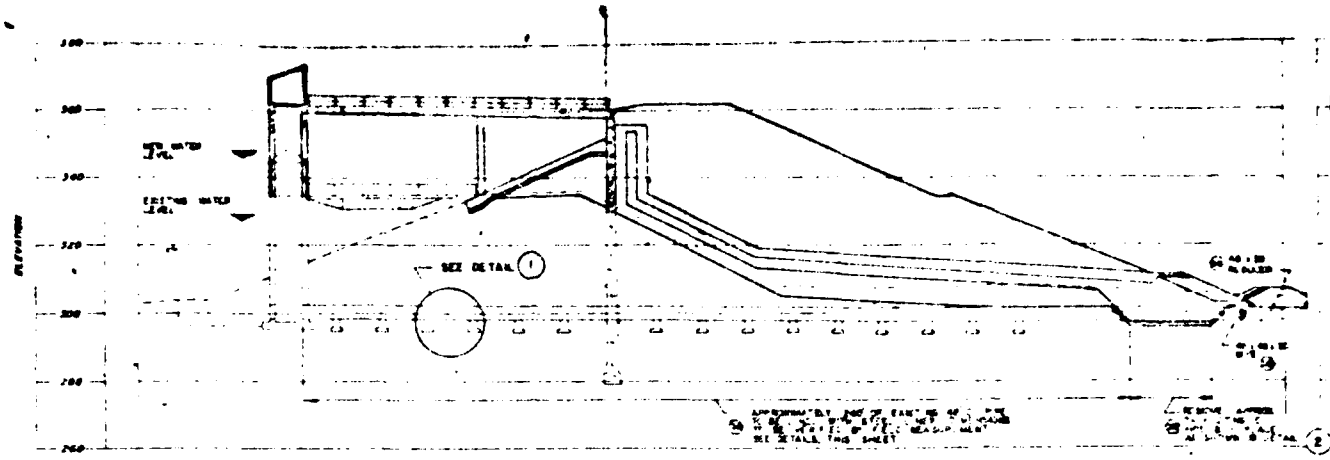
TOP OF DAM DETAIL
(STA. 18+90 TO STA.19+60)

PHOTO REDUCED
NOT TO SCALE

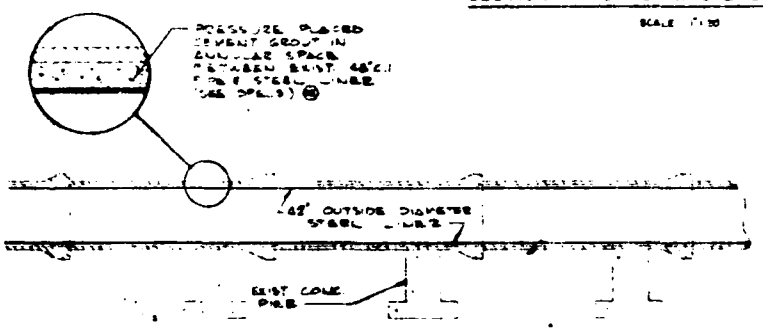
DEPARTMENT OF PUBLIC UTILITIES HARTFORD, CONNECTICUT U.S. DEPT. OF COMMERCE EDA PROJECT NO. 01-0088
DEEP RIVER DAM AND WATER PURIFICATION PLANT EARTH DAM DWG. TYPICAL SECTIONS
Date Scale AS NOTED — SHEET D-17 OF D-48
CHARLES A. MANOLESE & ASSOCIATES INC.

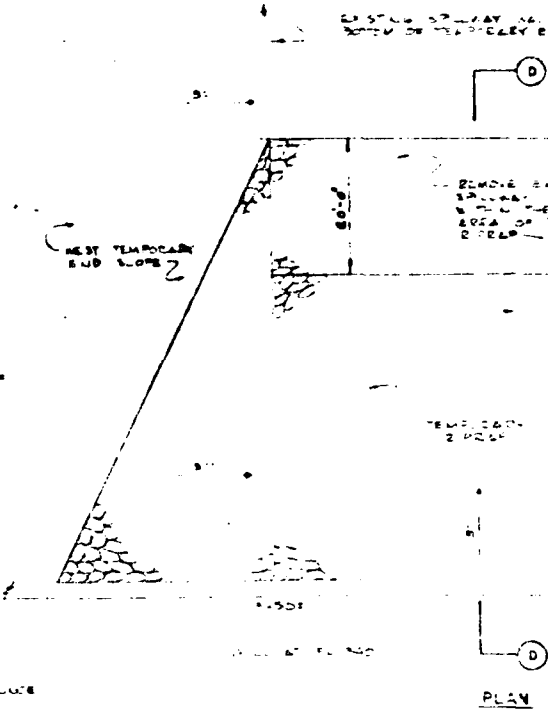
Designed by S.P.S.
Drawn by S.A.S.
Checked by S.A.S.
Approved

(1)



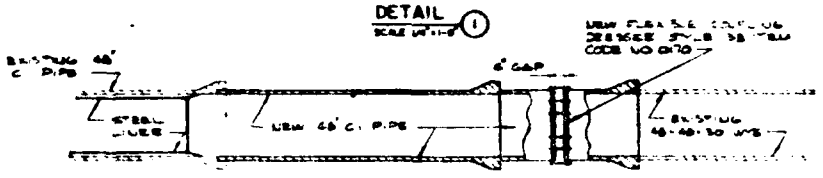
SECTION THRU 48" WASTE & SUPPLY LINE



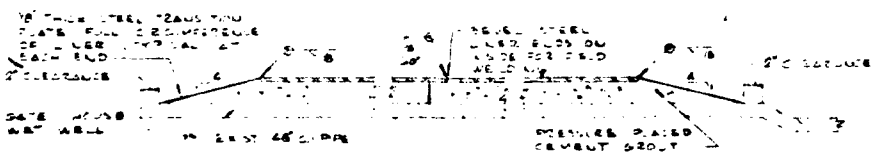


PLAN

DETAIL (1)



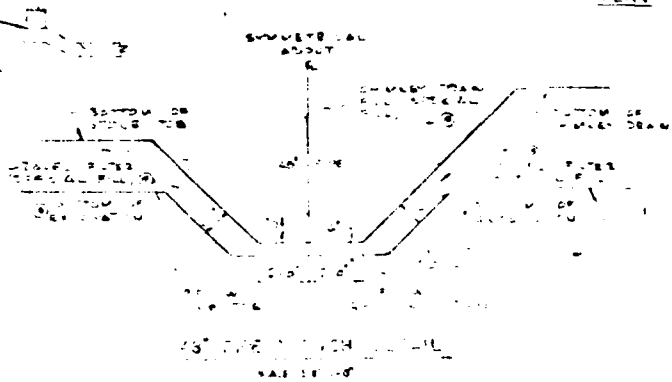
DETAIL (2)

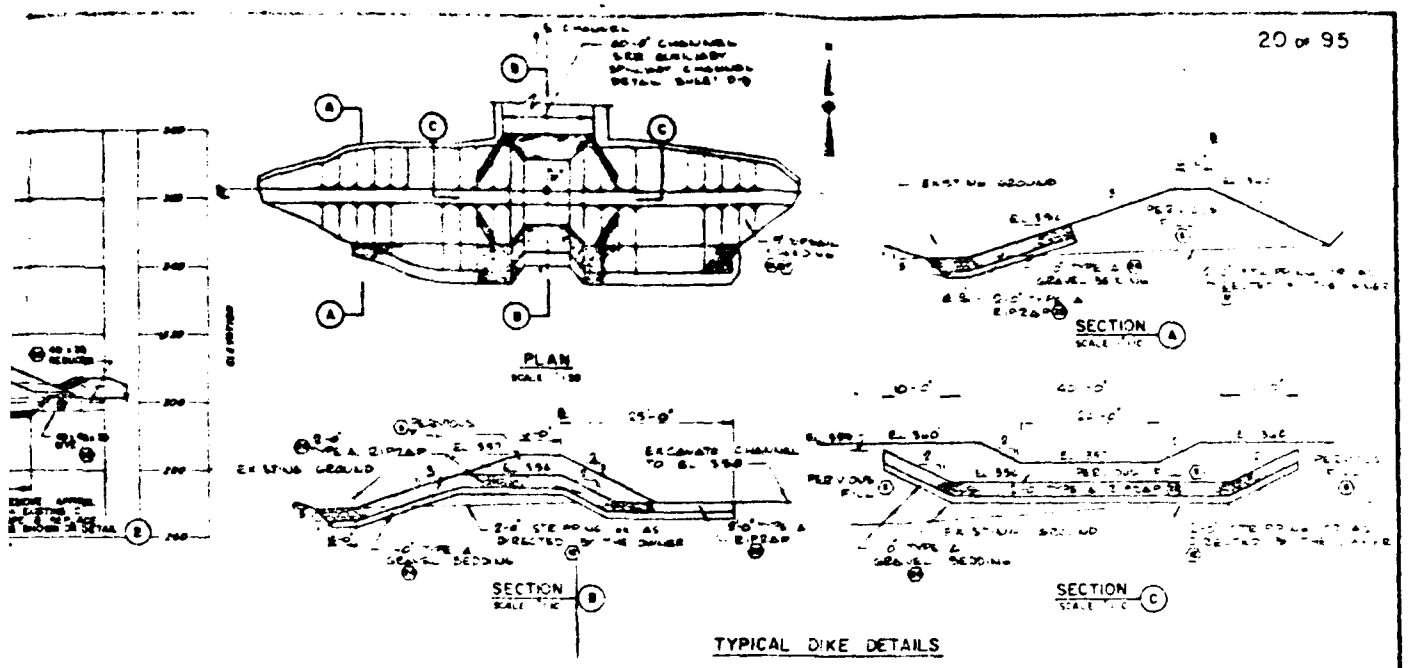


SOUTH END TYPICAL JOINT NORTH END

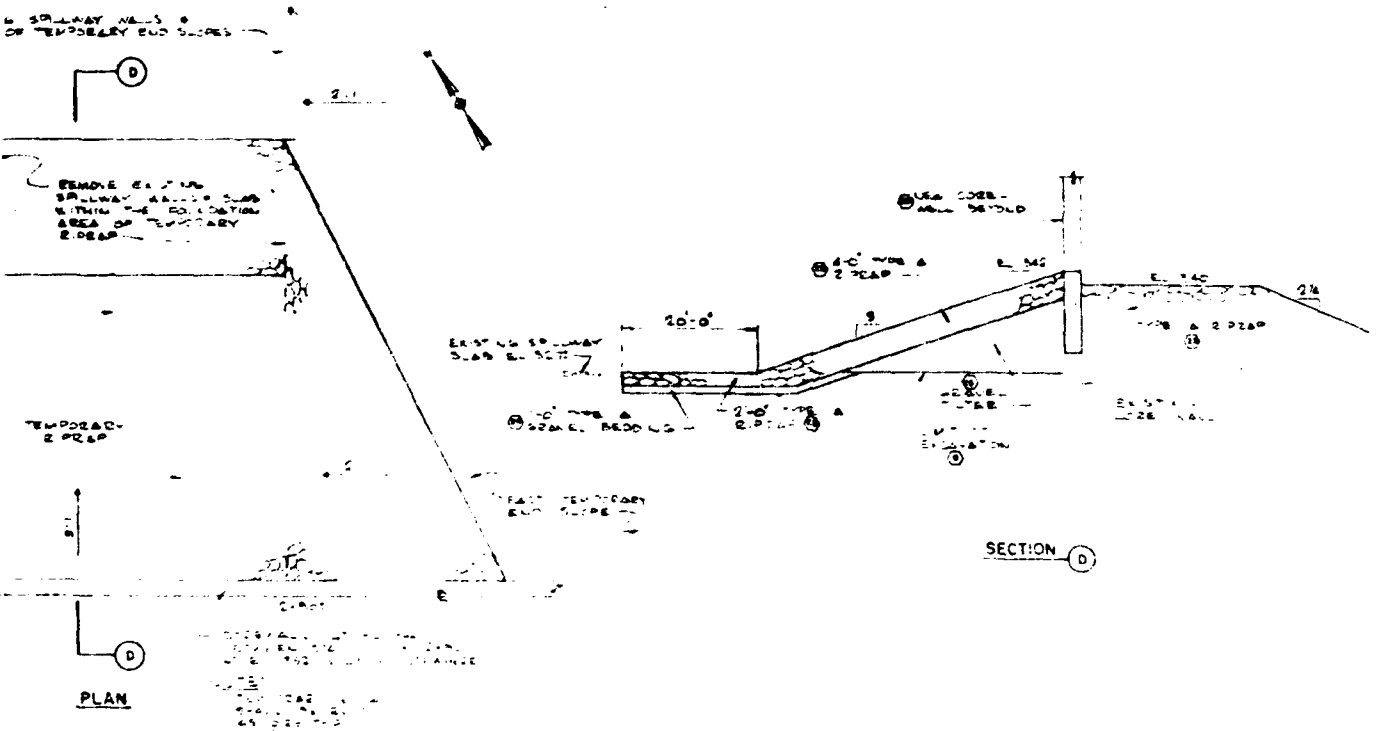
STEEL LINER DETAIL

NOTES



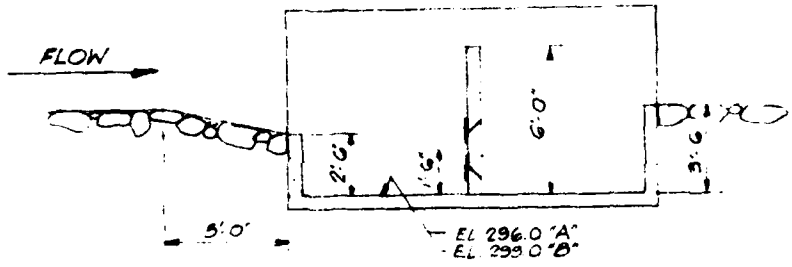


TYPICAL DIKE DETAILS



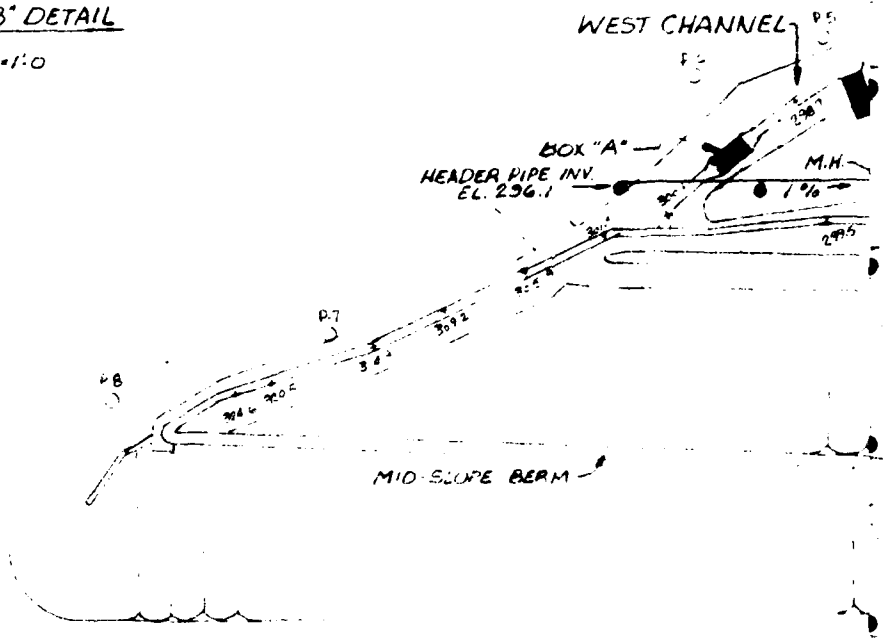
TEMPORARY RIPRAP AT EXISTING SPILLWAY

NOTE:
PHOTO REDUCED – NOT TO SCALE

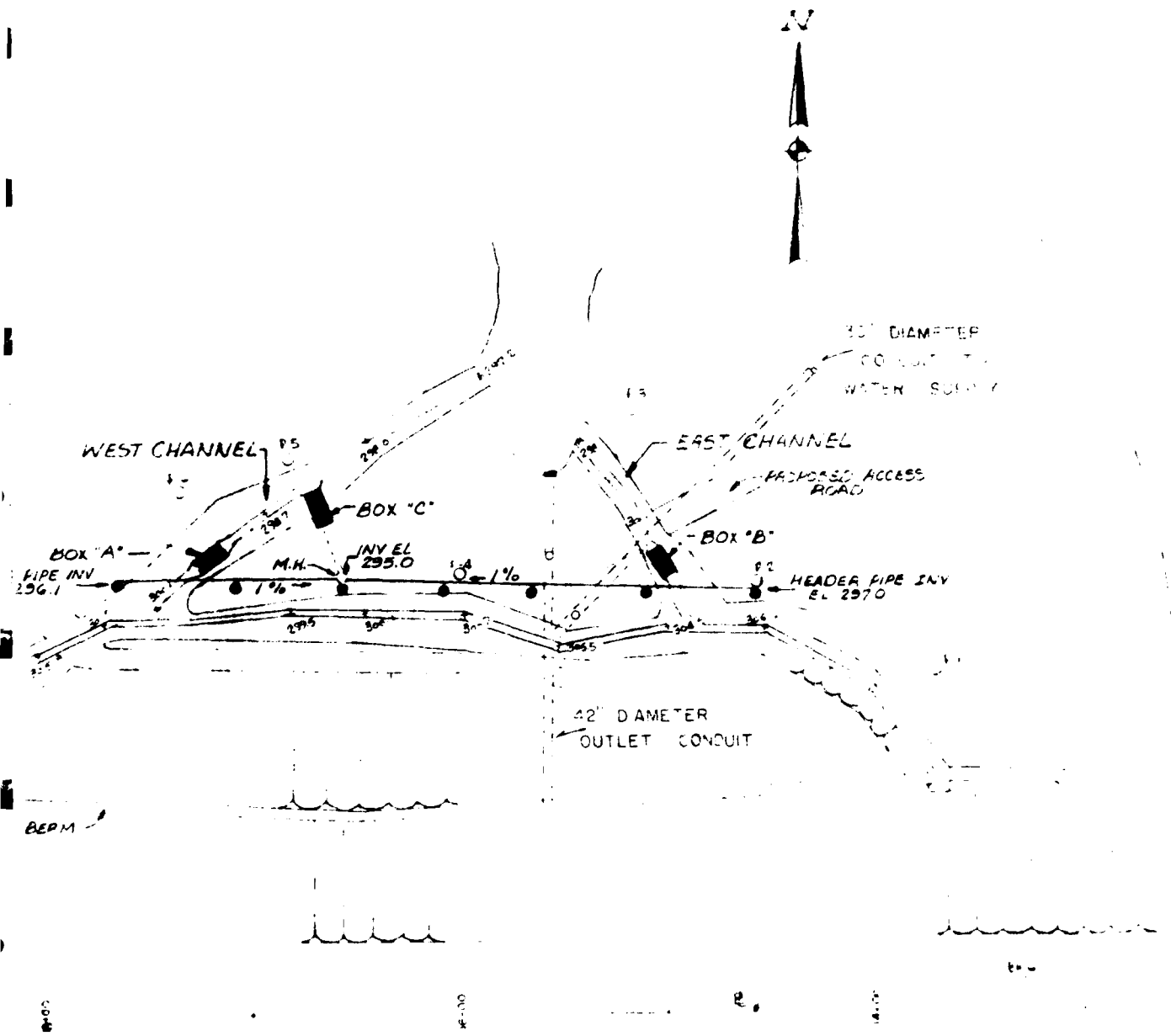


BOX "A" & "B" DETAIL

SCALE 1/8" = 1'-0

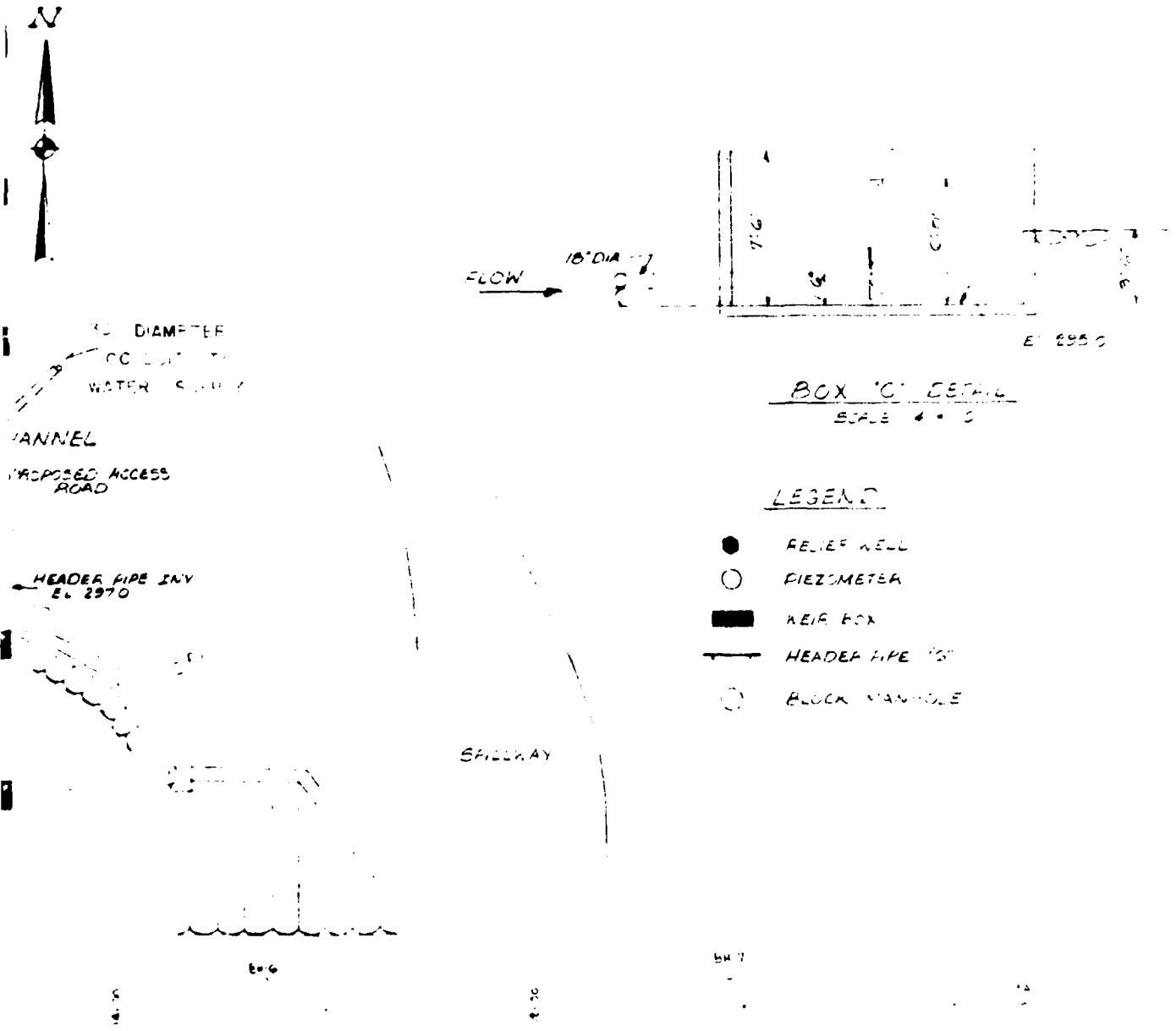


LAYOUT C



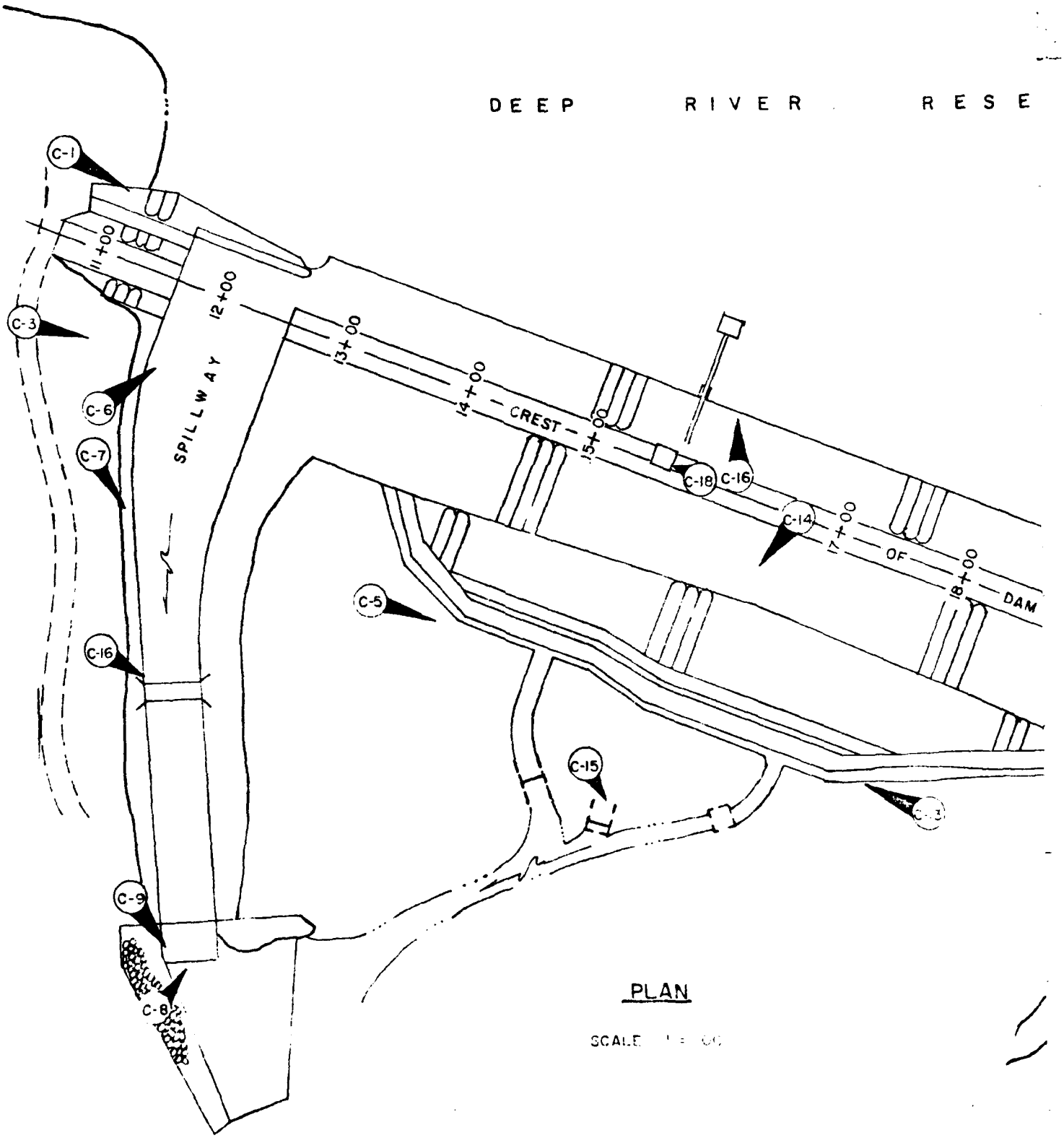
LAYOUT OF RELIEF WELLS & GAGING BOXES

SCALE 1" = 40'-0"


N
FLOW
18" DIA
DIAMETER
WATER
ANNEL
PROPOSED ACCESS ROAD
HEADER PIPE INV EL 2970
SPILLWAY
EL 2950
BOX 'C' DETAIL
SCALE
LEGEND
RELIEF WELL
PIEZOMETER
WEIR BOX
HEADER PIPE 'S'
BLOCK MANHOLE
BOXES

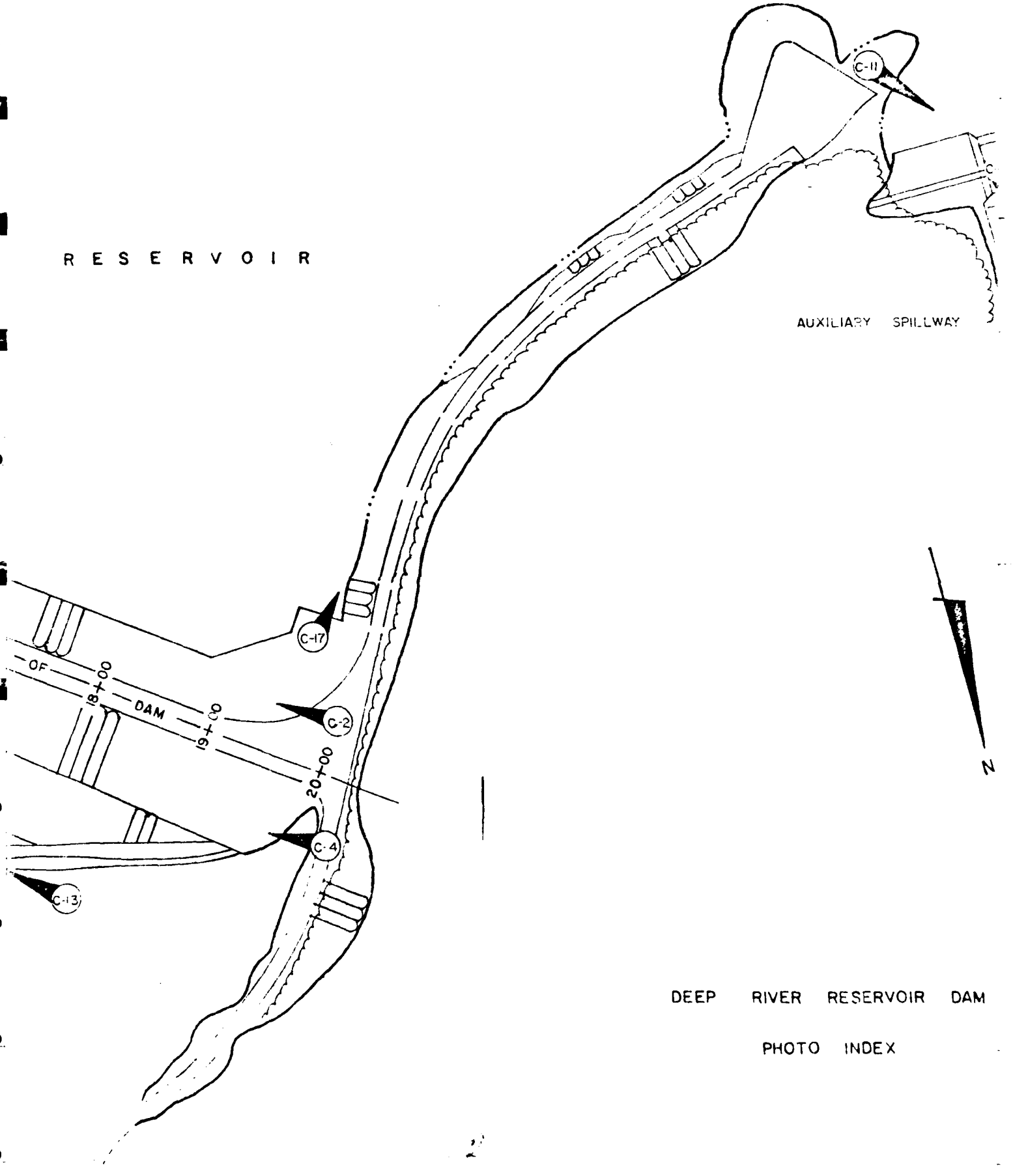
APPENDIX C

PHOTOGRAPHS



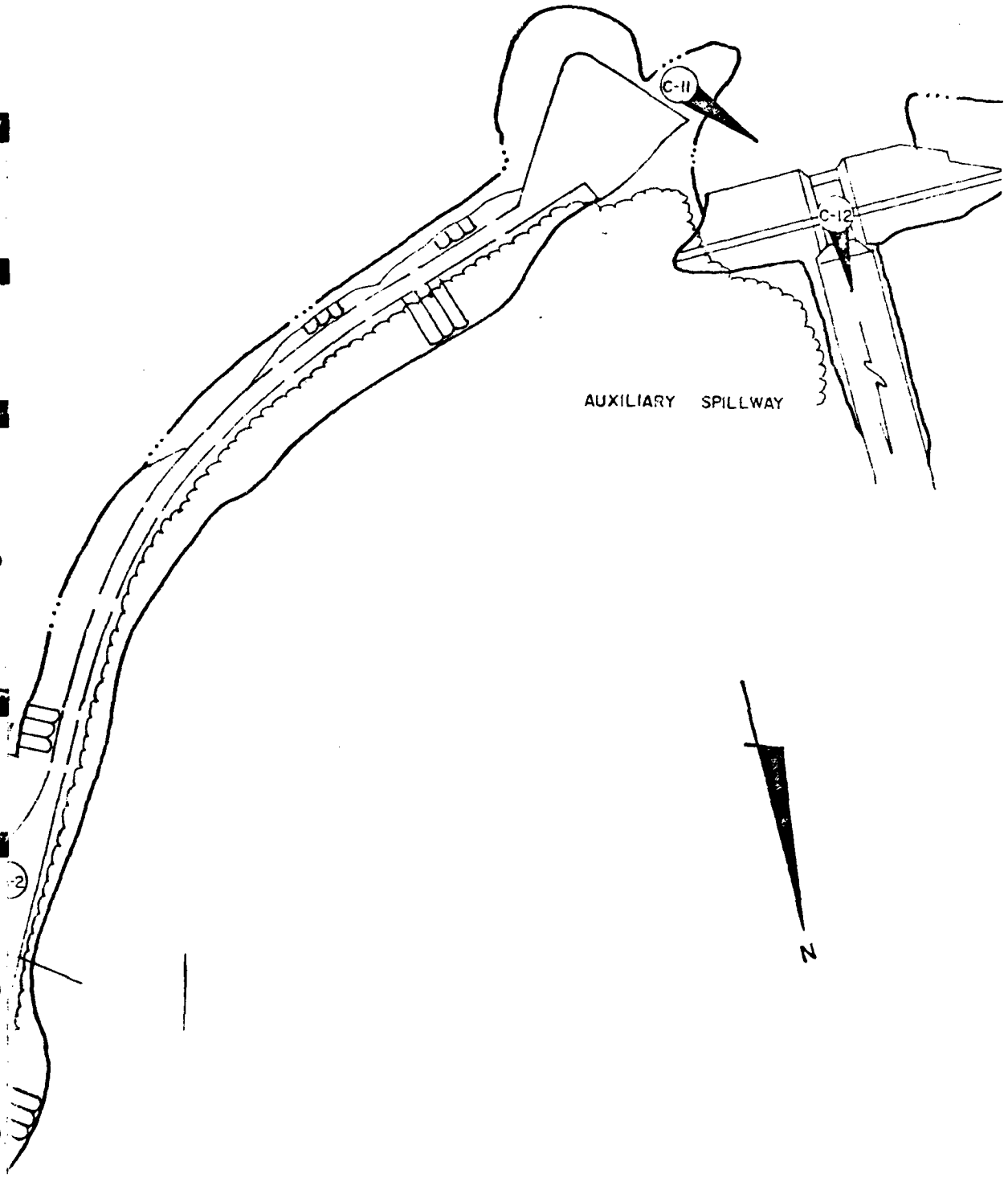
PLAN

SCALE 1" = 100'



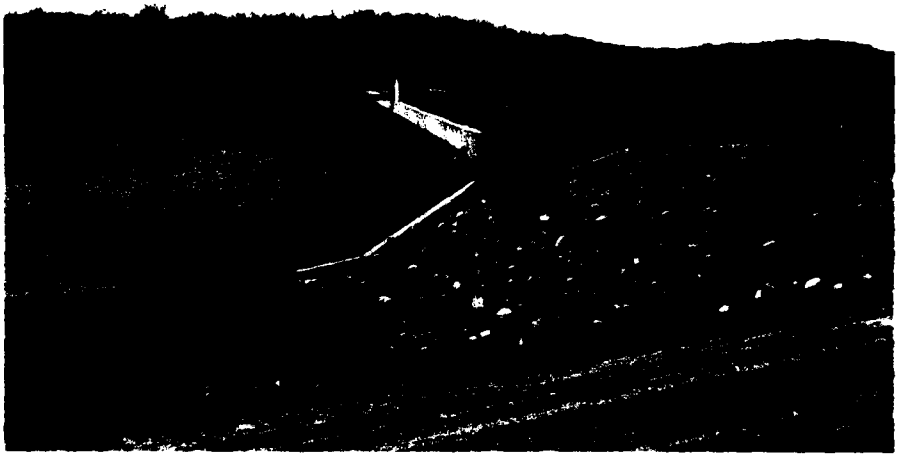
DEEP RIVER RESERVOIR DAM

PHOTO INDEX

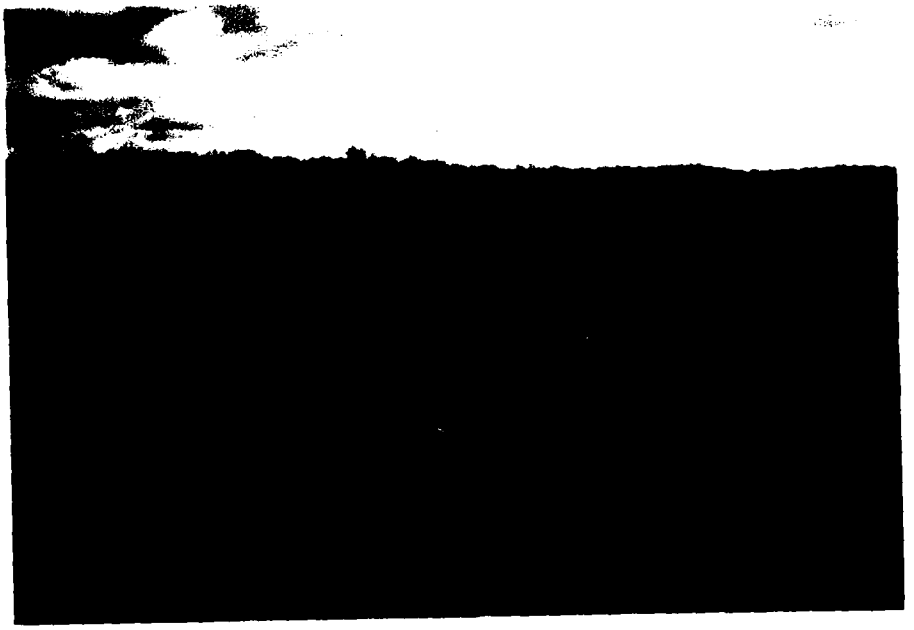


DEEP RIVER RESERVOIR DAM

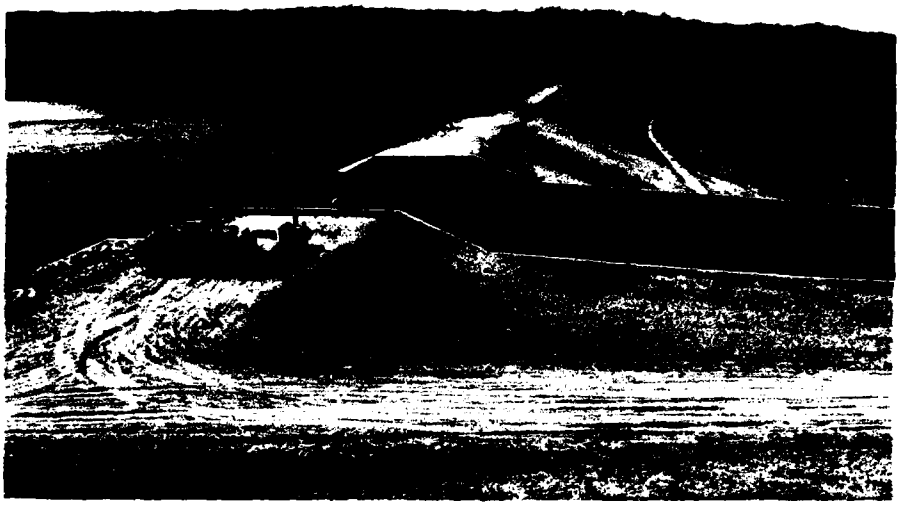
PHOTO INDEX



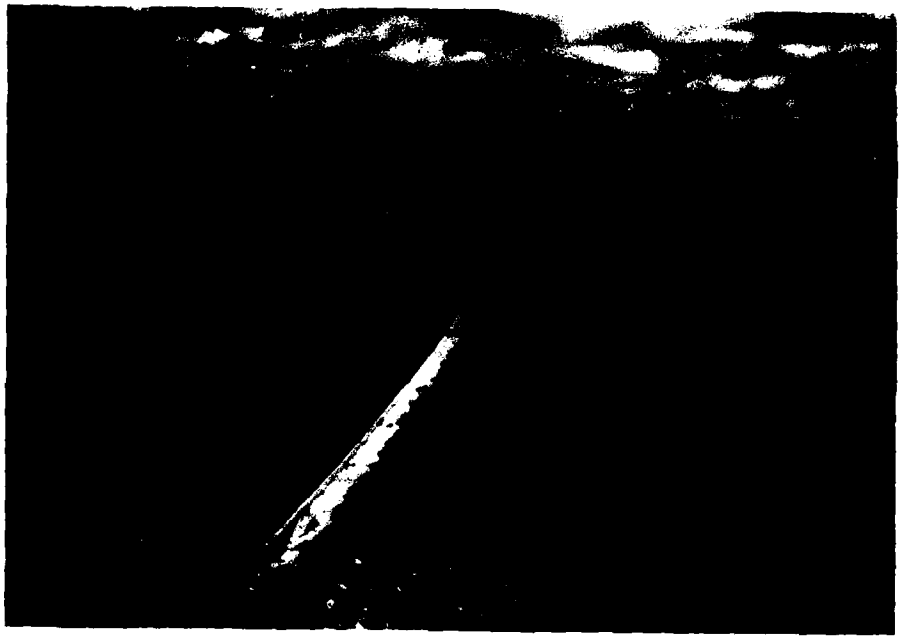
C-1 UPSTREAM SLOPE OF EMBANKMENT FROM RIGHT ABUTMENT



C-2 UPSTREAM SLOPE OF EMBANKMENT FROM LEFT ABUTMENT

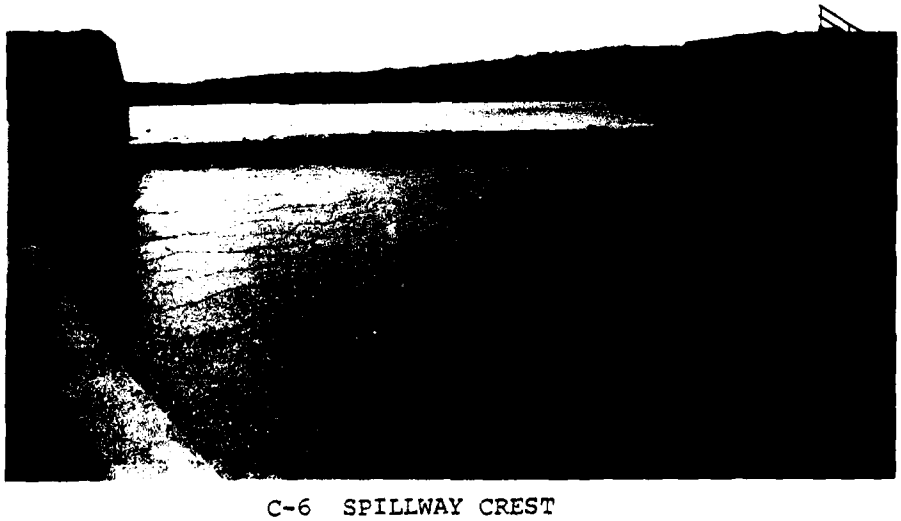


C-3 CREST AND DOWNSTREAM SLOPE FROM RIGHT ABUTMENT

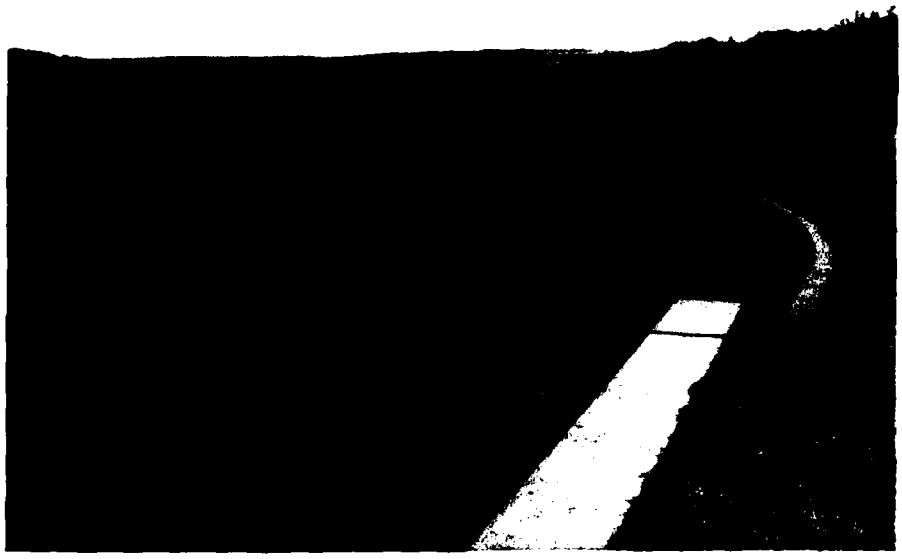


C-4 DOWNSTREAM SLOPE OF EMBANKMENT FROM LEFT ABUTMENT

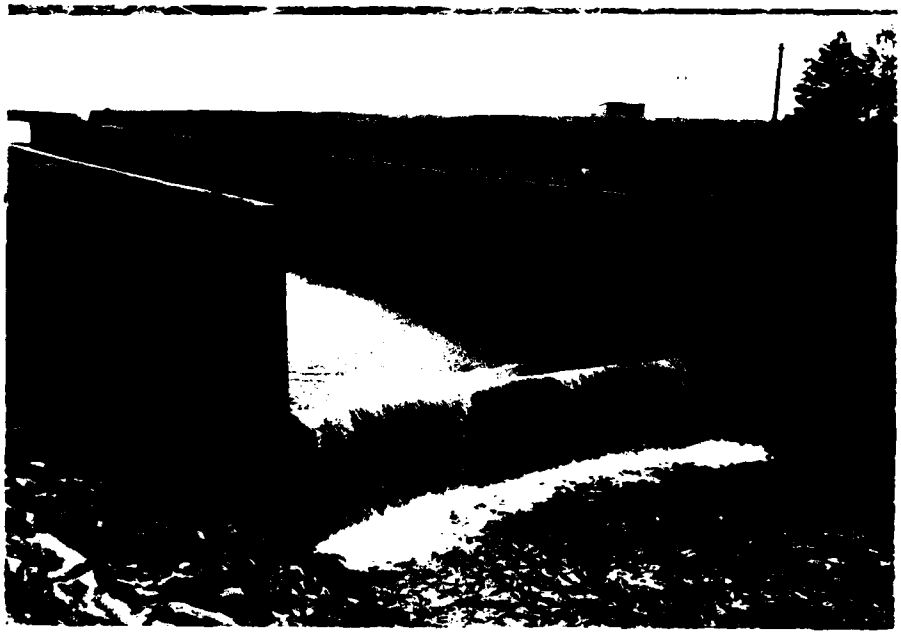
C-5 DOWNSTREAM TOE OF EMBANKMENT FROM RIGHT SIDE



C-6 SPILLWAY CREST

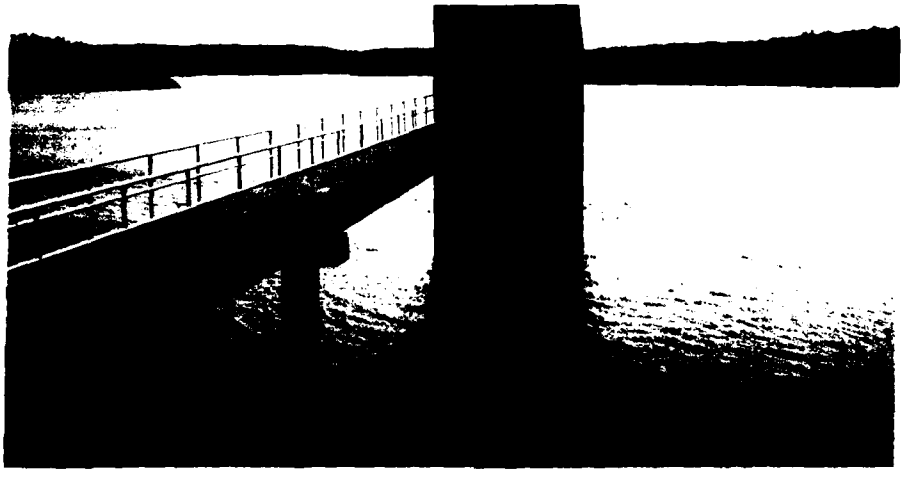


C-7 SPILLWAY CHUTE LOOKING DOWNSTREAM



C-8 SPILLWAY DISCHARGE

C-9 SPILLWAY DISCHARGE CHANNEL LOOKING DOWNSTREAM



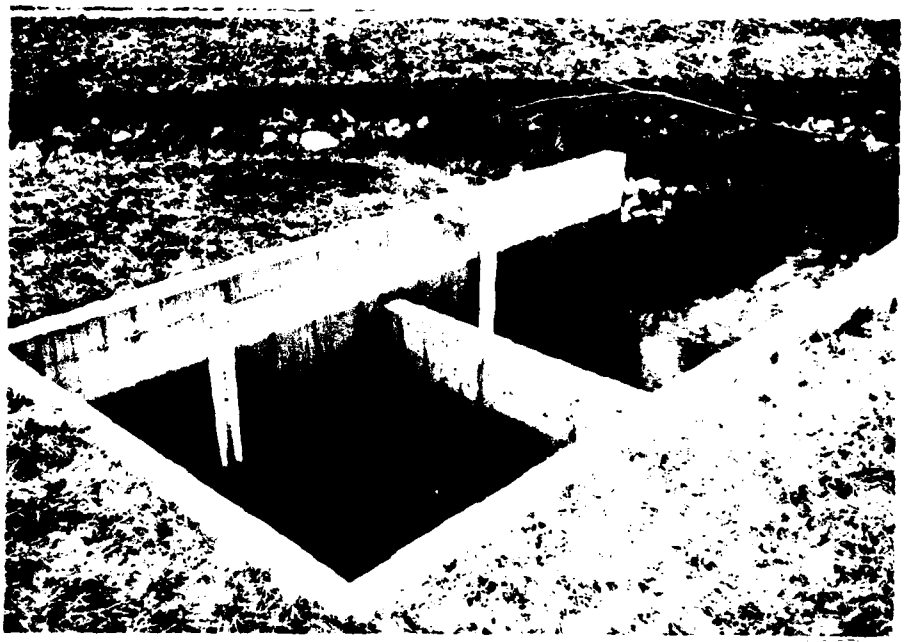
C-10 OUTLET WORKS CONTROL TOWER

C-11 EMERGENCY SPILLWAY CREST ("FUSE PLUG")

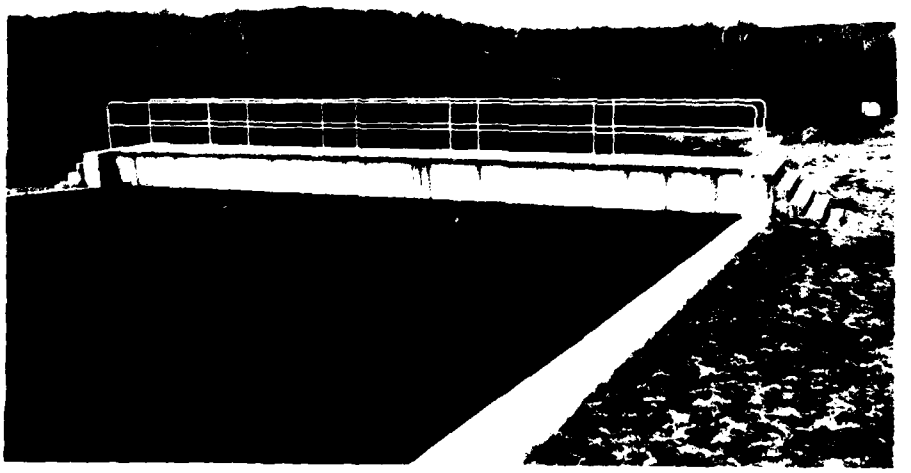
C-12 EMERGENCY SPILLWAY DISCHARGE CHANNEL LOOKING DOWNSTREAM

C-13 SEEPAGE CHANNEL AT TOE OF EMBANKMENT

C-14 VIEW OF WEIR BOXES AND SEEPAGE CHANNELS AT TOE OF DAM

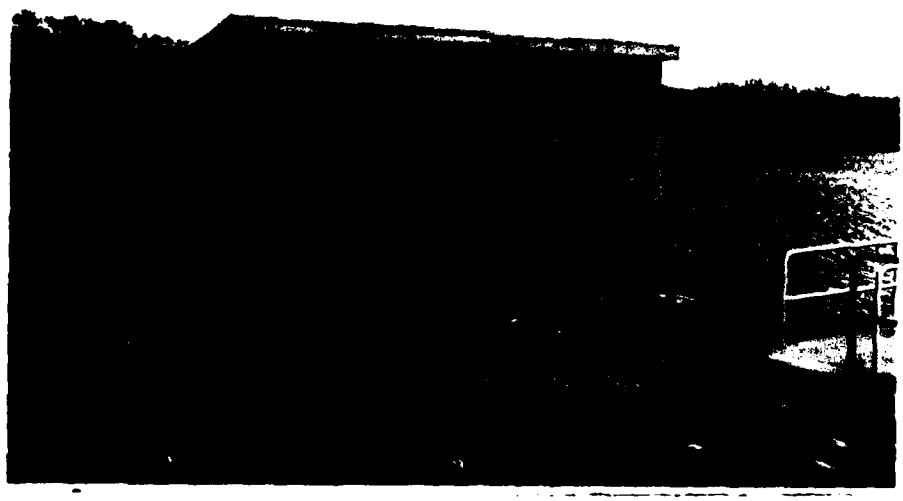


C-15 WEIR BOX FOR SEEPAGE MEASUREMENT (1 of 3)



C-16 SERVICE BRIDGE ACROSS SPILLWAY

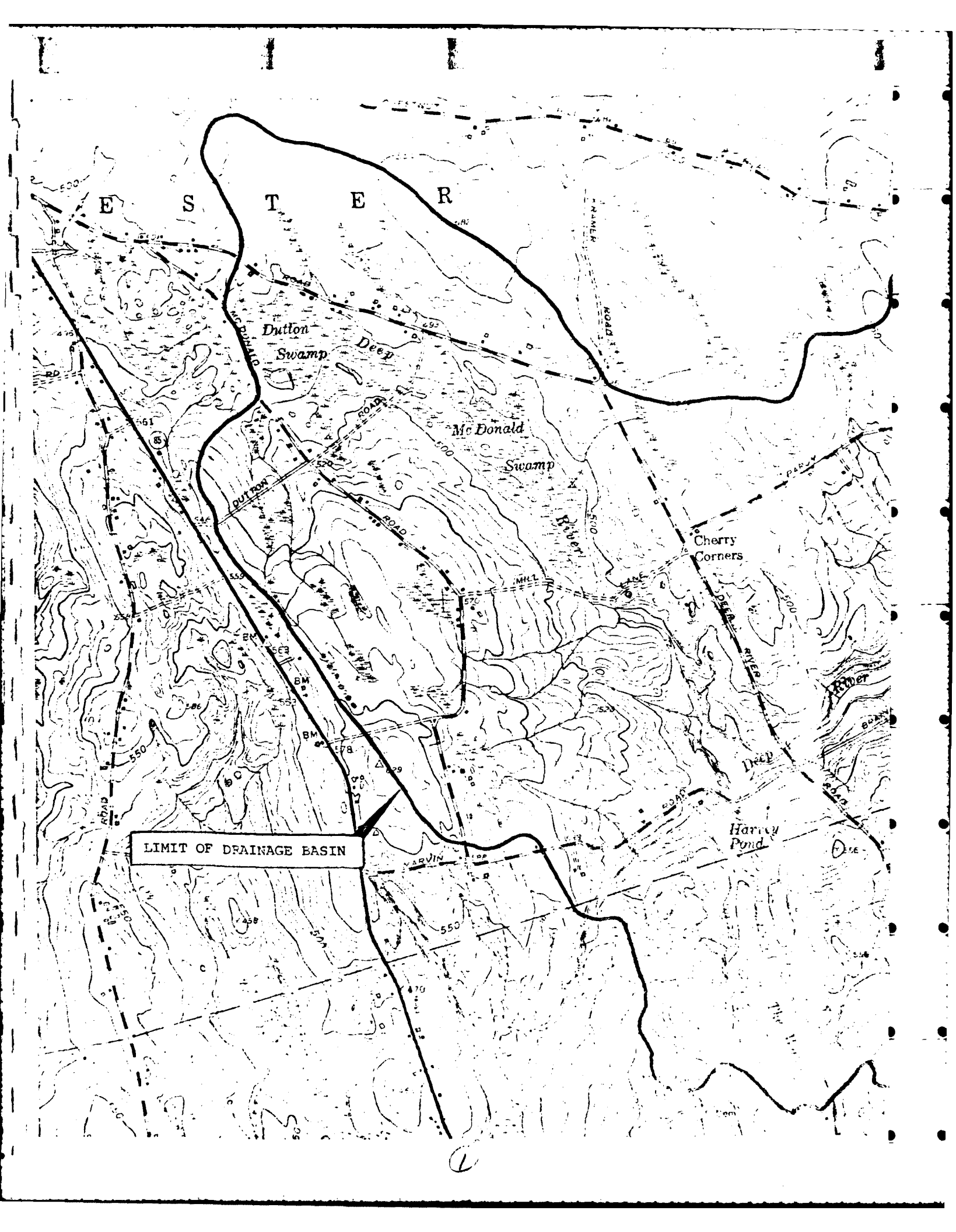
C-17 EROSION AREA NEAR LEFT ABUTMENT

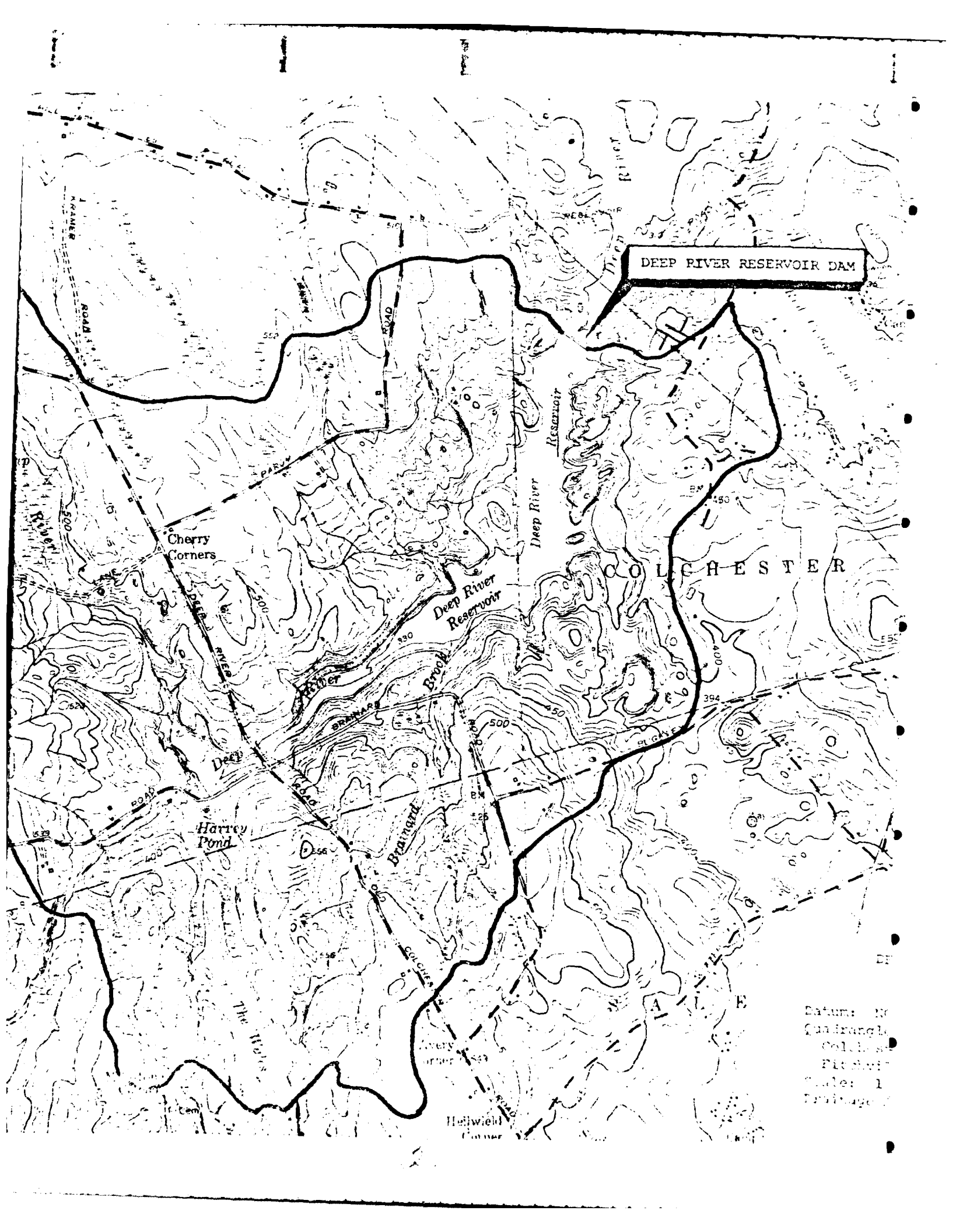


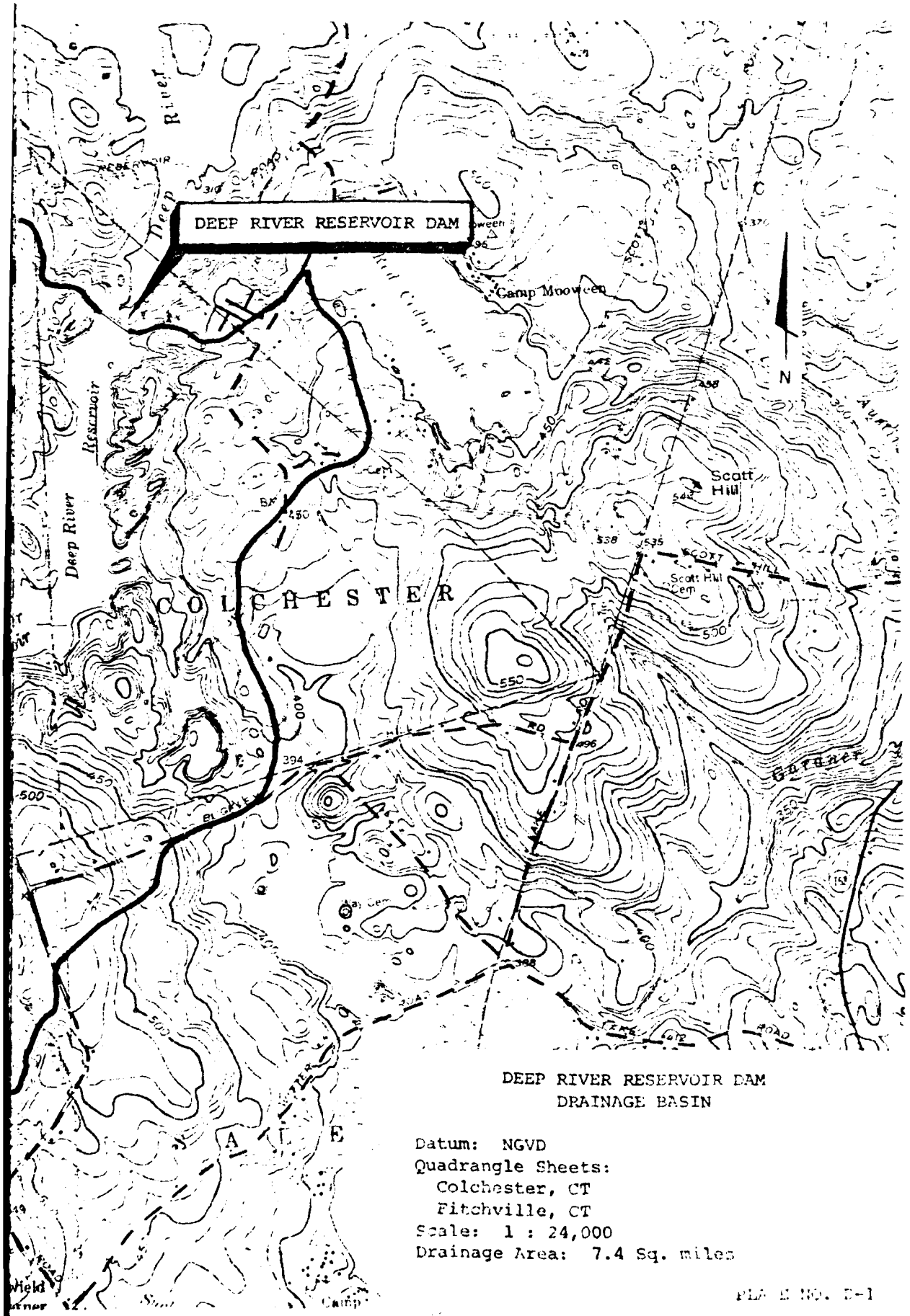
C-18 AIR COMPRESSOR BUILDING ON CREST OF DAM

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS


E S T E R
Dutton Swamp
Deep
McDonald Swamp
Cherry Corners
Deep River
Harvey Pond
LIMIT OF DRAINAGE BASIN

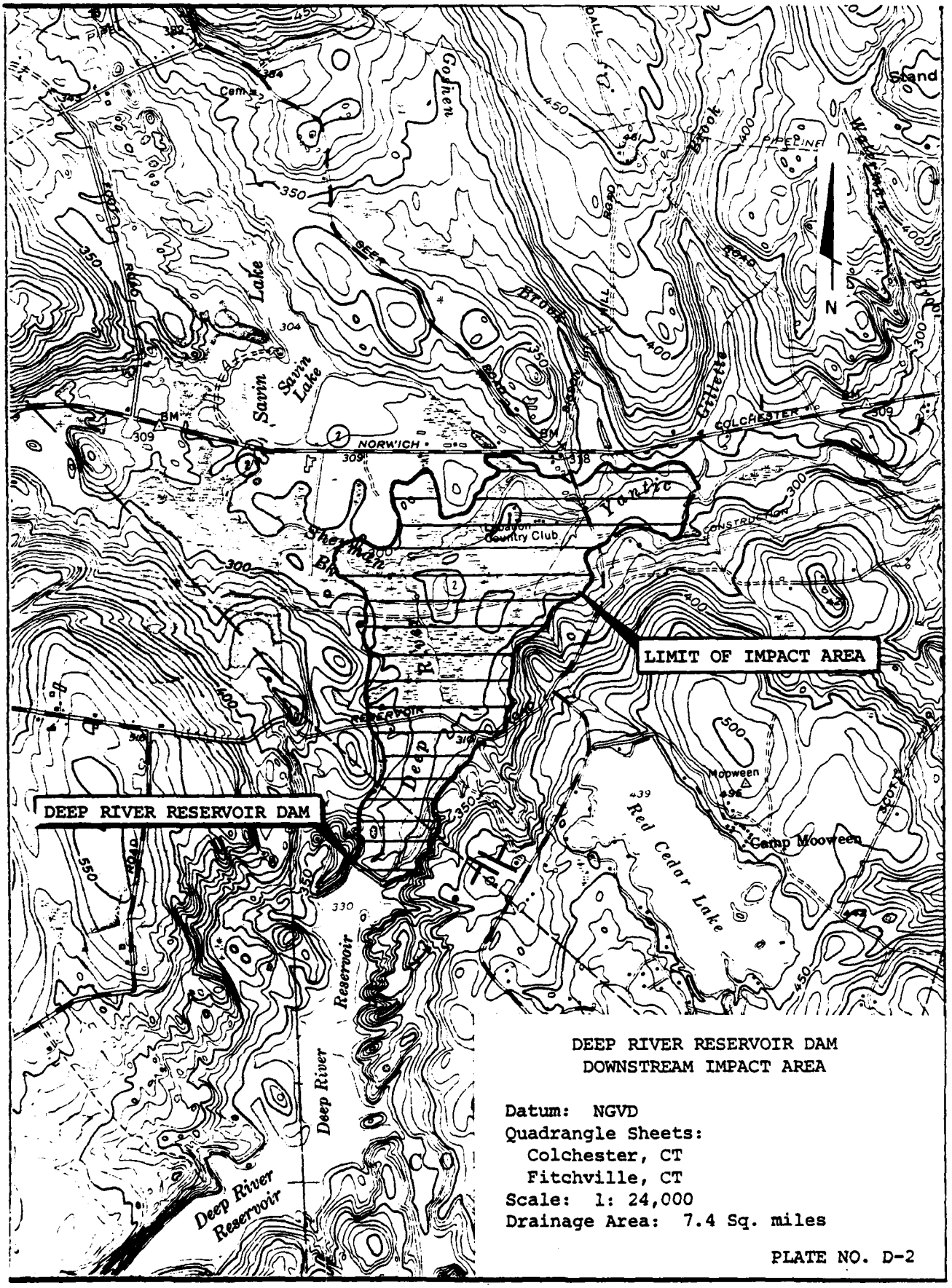

DEEP RIVER RESERVOIR DAM
Deep River Reservoir
Deep River
Cherry Corners
Deep River Reservoir
COLCHESTER
Harvey Pond
Brainard Brook
Hollwield Corner



DEEP RIVER RESERVOIR DAM
DRAINAGE BASIN

Datum: NGVD
Quadrangle Sheets:
Colchester, CT
Fitchville, CT
Scale: 1 : 24,000
Drainage Area: 7.4 Sq. miles

PLATE NO. D-1



DEEP RIVER RESERVOIR DAM
DOWNSTREAM IMPACT AREA

Datum: NGVD
Quadrangle Sheets:
Colchester, CT
Fitchville, CT
Scale: 1: 24,000
Drainage Area: 7.4 Sq. miles

PLATE NO. D-2

Deep River Reservoir Dam

A. Size Classification

Height of dam = 62.0 ft.; hence Intermediate

Storage capacity at top of dam (elev. 362.0) = 8500 AC-FT.; hence Intermediate

Adopted size classification Intermediate

B.i) Hazard Potential

Dam is located in rural section of a suburban area and is a source of water supply to the City of Norwich. Water treatment plant is located downstream, and failure of dam will cause appreciable damage and adversely affect the water supply system.

ii) Impact of Failure of Dam at Maximum Pool (Top of Dam)

It is estimated from the rule of "thumb" failure hydrograph, that the following adverse impacts are a possibility by the failure of this dam.

a)	Loss of life	Yes	- to - lives can be lost.
b)	Loss of homes	Yes	1 to 2 homes can be lost.
c)	Loss of buildings	Yes	1 to 2 buildings can be lost.
d)	Loss of highways or roads	Yes	Route 2 roads can be damaged.
e)	Loss of bridges	Yes	1 to 2 bridges can be lost.
f)	Miscellaneous	Yes	Water supply system will be disrupted. Treatment plant could be damaged.

The failure profile can affect a distance of 8000 feet from the dam. For water surface elevation, see next page in Appendix D.

C. Adopted Classifications

HAZARD	SIZE	TEST FLOOD RANGE
High	Intermediate	PMF

Adopted Test Flood = Full PMF = 2700 CSM

= 20000 CFS

D. Overtopping Potential

Drainage Area 4736 Acres = 7.4 sq. miles

Spillway crest elevation = 348.0 NGVD

Top of Dam Elevation = 362.0 NGVD

Maximum spillway discharge

Capacity without overtopping of dam = 18860 CFS

"test flood" inflow discharge = 20000 CFS

"test flood" outflow discharge = 13000 CFS

% of "test flood" overflow carried by spillway without overtopping = 100%

"test flood" outflow discharge portion which overflows over the dam = -

% of test flood which overflows over the dam = -

Deep River Reservoir Dam

Dam Failure Analysis

1. Failure discharge with pool at top of dam (elev. 362.0) = 124000 CFS

2. Depth of water in reservoir at time of failure = 61.0 ft.

3. Maximum depth of flow downstream of dam) at time of failure) = 40 ft.

4. Water surface elevation just downstream) of dam at time of failure) = 341.0 NGVD

The failure discharge of 124000 CFS will enter Deep Riv. Brook and flow downstream 8000 feet until the brook crosses Route 2 and joins Yantic Riv. There is significant valley storage in this 8000 feet length of brook to reduce the discharge substantially. Also due to roughness characteristics, obstructions and frictional losses, it is very likely that the unsteady dam failure flow will dissipate its wave and kinetic energy and thus convert to steady and uniform flow obeying Manning's formulae 8,000 feet downstream. The failure profile will have the following hydraulic characteristics:

DISTANCE FROM THE DAM	WATER SURFACE ELEVATION NGVD	REMARKS
0 + 00	362.0	Upstream of dam
0 + 00	341.0	Downstream of dam
10 + 00	330.0	
20 + 00	325.0	
30 + 00	320.0	
40 + 00	315.0	
50 + 00	310.0	
60 + 00	305.0	
70 + 00	300.0	
80 + 00	295.0	

Beyond 8000 feet and until the brook joins Yantic, the failure discharge will flow in the below given channel characteristics:

Q = 100000 CFS; S = 0.005

n = 0.05; b = 1800 ft.; d = 8.0 ft.

Side slopes = 1V or 2H.

Estimating Maximum Probable Discharges - Inflow and Outflow Values Date of Inspection: _____

Name of Dam Deep River Reservoir Dam ; Location of Dam Deep River ; Town Norwich, Conn.

Watershed Characterization Rolling Terrain and hilly areas ; 0.37 sq. miles of drainage area is swampy or occupied by storage reservoirs

Adopted "test" flood = Full PMF = CSM = 20000 CFS; Re = Effective Rainfall = 19.0 inches

D.A. = Drainage Area (Gross) = 7.4 Square Miles; Basin Slope = 0.05 ± hence; Moderate to steep

S.A. = Surface Area of Reservoir at Spillway Crest = 0.38 Square Miles; Time of Concentration = 2-4 hours

S.A. at top of dam = 0.50 sq. mi.

Shape and Type of main Spillway = ogee-type overflow spillway with a chute downstream (Crest Elev. 348.0)

" " " " auxiliary spillway = 40 ft. wide trapezoidel with 2:1 side slopes. (Crest Elev. 354.0)

B = Width of main Spillway = 90 feet; C = Coefficient of Discharge = (4.08-Friction) = 4.0

At dike Elev. 360.0 Maximum Capacity of main Spillway Without Overflow = 14960 CFS = 100 % of test flood outflow

" " " " " " " auxiliary spillway without Overtopping = 2293 CFS =

Top of Dam Elevation = 362.0 ; Spillway Crest Elevation = 348.0

Overflow portion of Length of Dam = 900 ft. ; C = Coefficient of discharge for Dam = 3.0

Name of Dam	Test Flood Q_p CSM	Test Flood Q_p CFS	Inflow Characteristics h_0 in feet	Inflow Characteristics S_0 in in.	Outflow Characteristics First Approximation Q_{p1} CFS	h_1 in ft.	S_1 in in.	Outflow Characteristics Second Approximation S_2 in in.	h_2 in ft.	Q_{p2} CFS	Outflow Characteristics Third Approximation (Adopted) S_3 in in.	h_3 in ft.	Q_{p3} CFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Deep River Reservoir Dam.	PMF =2700	20000	Outflow characteristics performed by actual routing computations due to availability of storage-elevation curve								8.36	11.8	13000
	1/2 PMF =1350	1000									5.06	7.2	7000

Q_p = Discharge; h = Surcharge height; S = Storage in inches

NOTE: Outflow discharge values are computed as per COE guidelines.

"Rule of Thumb Guidance for Estimating Downstream Dam Failure Discharge"

BASIC DATA

Name of dam Deep River Reservoir Dam Name of town Norwich, Conn.

Drainage area = 7.4 Sq. Mi. Top of dam 362.0 NGVD

Spillway type = ogee Type, overflow, uncontrolled Crest of spillway 348.0 NGVD

Surface area at crest elevation = 0.38 Sq. Mi.

Reservoir bottom near dam = 301.0 NGVD

Assumed side slopes of embankments 2H:1V

Depth of reservoir at dam site 61.0 ft = y_o = 61.0 ft.

Mid-height elevation of dam = 331.5 NGVD

Length of dam at crest = 900 feet

Length of dam at mid-height = 775 feet

___ of dam length at mid-height = W_b = 155

Step 1:

Elevation (NGVD)	Estimated Storage in AC-ft.	Surface Area in Acres	
362.0	8500	325	top of dam
360.0	7850	320	
358.0	7300	308	
356.0	6760	296	
354.0	6150	284	
352.0	5540	272	
350.0	4970	261	
348.0	4520	245	Crest spillway
340.0	2740	185	
330.0	1180	127	
325.0	645	87	
320.0	283	57	
315.0	93	19	
310.0	31	6	
300.0	0	0	

"Rule of Thumb Guidance for Estimating Downstream Dam Failure Discharge"

BASIC DATA

Step 2:

$$Q_{p1} = \frac{8}{27} W_b \sqrt{g}\, y_o^{3/2}$$

$$= \underline{\quad 1.68 \quad} W_b\, y^{3/2} = \underline{\quad 124000 \quad} \text{ cfs}$$

NOTE: Failure of dam is assumed to be instantaneous when pool reaches top of dam.

Failure is assumed as full depth and partial width failure.

DEEP RIVER RESERVOIR DAM

Computations for Spillway Rating curve and Outlet Rating Curve:

Main Spillway width = 90.0 feet; Crest Elevation = 348.0 NGVD
Auxiliary Spillway width = 40.0 ft; Crest Elevation = 354.0 NGVD
(Trapezoidel with 2:1 side slopes)
Length of dam = _____ feet; Top of Dam = 362.0 NGVD

C = 4:0 for Main Spillway; 3.0 for auxiliary spillway and dam

i) Spillway Rating Curve Computations

Elevation (ft.) NGVD	Spillway Discharge (CFS)		Total Spillway Discharge	Remarks
	Main Spillway	Auxiliary Spillway		
348.0	0	0	0	Crest of Main Spillway
350.0	1020	0	1020	
352.0	2880	0	2880	
354.0	5290	0	5290	Crest of Auxiliary "
356.0	8146	373	8519	
358.0	11384	1152	12536	
360.0	14960	2293	17253	Top of Dike
362.0	18860	3801	22661	Top of Dam

Notes:

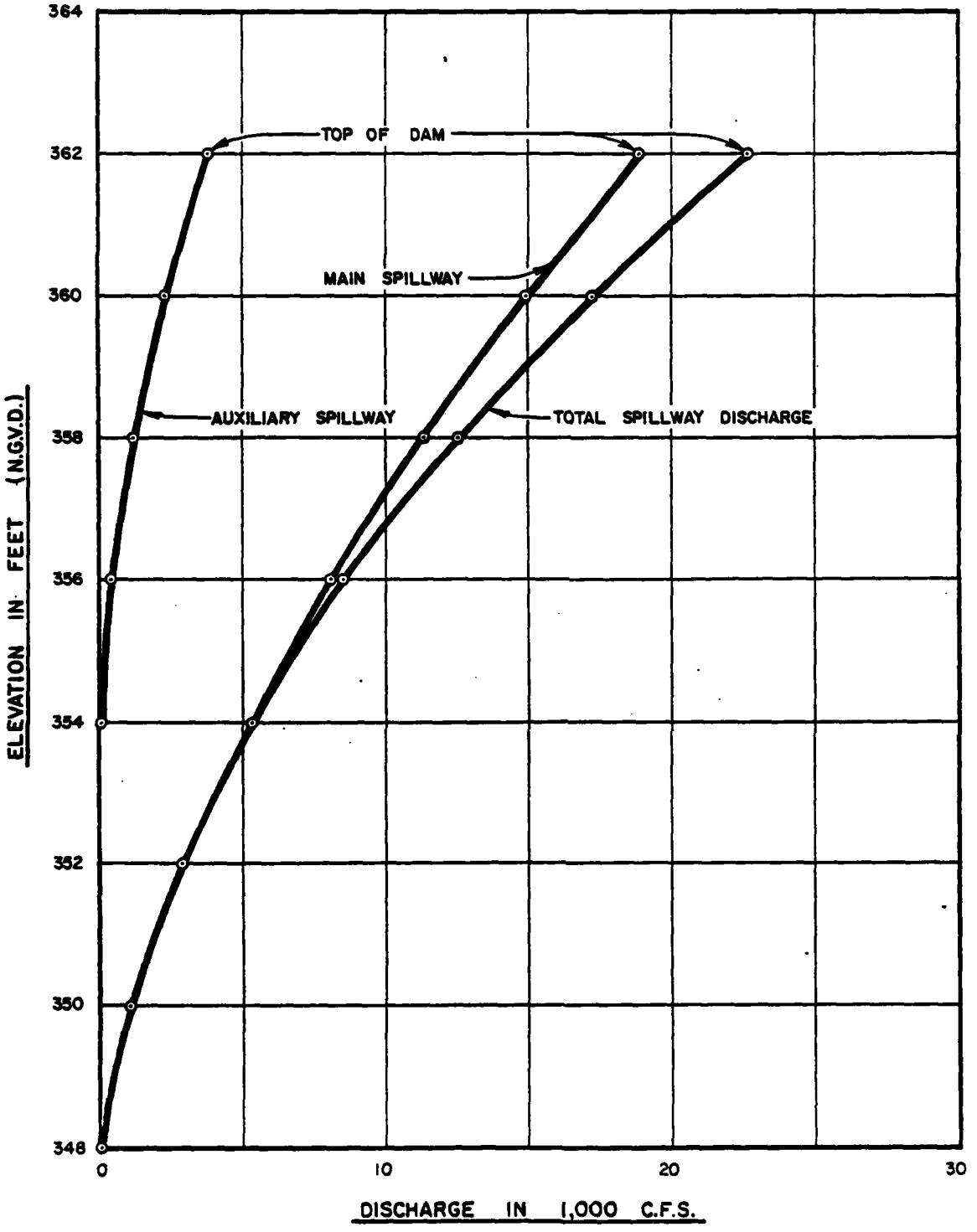
1. Maximum Main Spillway Capacity = 18860 CFS
2. Maximum Auxiliary Spillway Capacity = 3801 CFS
3. Total Spillway Discharge Capacity = 22661 CFS } At top of Dam
4. Maximum Outlet Discharge Capacity = 195 CFS
5. Total Maximum Discharge Capacity of Dam 22856 CFS

DEEP RIVER RESERVOIR DAM

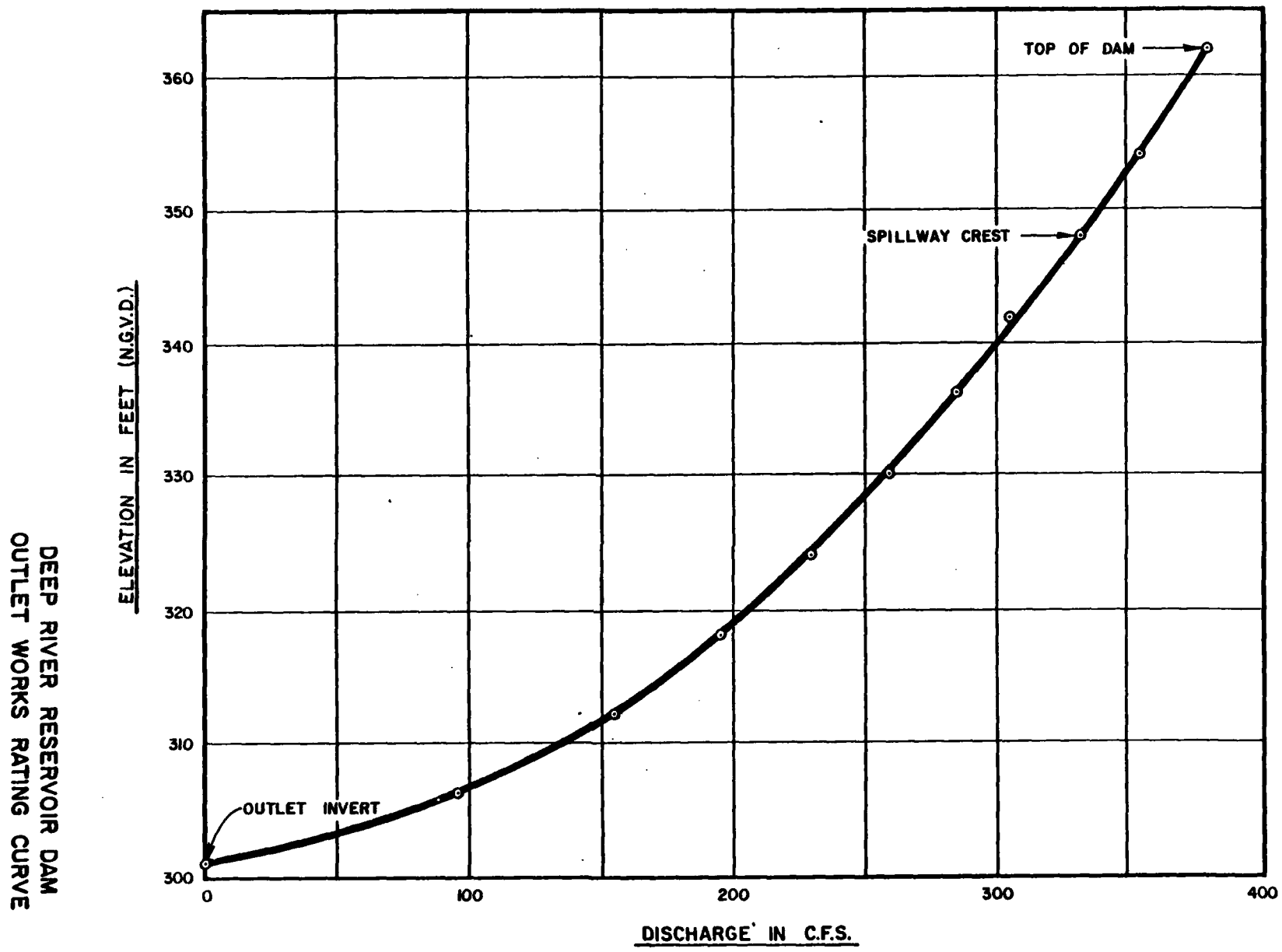
ii) Outlet Rating Curve Computations

Size of outlet=42"diameter pipe converging to 30" diameter
Area of 30" diameter outlet = 4.908 sq. ft.
Invert of outlet = 301.00 NGVD
c_d = 0.64

Elevation (ft.) NGVD	Discharge in CFS	Remarks
362.0	382	Top of Dam
354.0	355	
348.0	333	Spillway Crest
342.0	312	
336.0	286	
330.0	260	
324.0	231	
318.0	196	
312.0	155	
306.0	96	
301.0		Invert of Outlet



DEEP RIVER RESERVOIR DAM
SPILLWAY RATING CURVES



DEEP RIVER RESERVOIR DAM
OUTLET WORKS RATING CURVE

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

END

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